TRANSACTIONS

AND

PROCEEDINGS

OF THE

NEW ZEALAND INSTITUTE

1879

VOL. XII.

EDITED AND PUBLISHED UNDER THE AUTHORITY OF THE BOARD OF GOVERNORS OF THE INSTITUTE

BY

JAMES HECTOR, C.M.G., M.D., F.R.S.

ISSUED, MAY 1880.

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WELLINGTON:
LYON & BLAIR, PRINTERS, LAMBTON QUAY.
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PREFACE.

The Editor has to acknowledge the assistance of the following gentlemen in revising their papers for the press:—Messrs. Frankland, Kirk, T. W. Kirk, Buchanan, Knight, Skey, Kemp, and Newman.

While doing so he would call the attention of writers to the necessity for great care in preparing their manuscript for the printer. It is impossible that a volume of such varied contents can be entirely free from error, but the difficulty of deciphering manuscript adds much both to the chance of error and the expense of publication. In some cases it has been possible to print papers with any approach to correctness only by a careful study of the author's mode of forming letters, aided by reference to dictionaries and catalogues. A scientific record such as our Transactions is only of value if exact; and the Editor makes these remarks purely with the intention of averting the irritation often caused to writers by the occurrence of mistakes (arising from imperfections in the manuscript), which they are perhaps inclined to attribute to the editing branch of the Institute.

An acknowledgement is due to Mr. Buchanan for drawing the illustrations on stone, and to Mr. Gore for the meteorological record. Also to the officers of the lithographic and photo-lithographic departments, who, by the kind permission of the Colonial Secretary, have assisted in the completion of the plates.

ADDENDA ET CORRIGENDA.

PAGE

115, line 3 from below, *for* Ctenopodium *read* Chenopodium.

159, line 19, *for* native *read* Nature.

160, line 4, and 163, line 9, *for* Kaipara-te-hau *read* Ka-para-te-hau.

162, line 3, *for* Rongi *read* Rongo.

227, line 6, *for* Munipari *read* Munipuri.

228, in the second table, *after* sadikit *insert* kichi.

229, line 16, *for the first* ayo *read* aya.

230, line 5, *for* Khambi *read* Khamti.

„ in the second table, *under* tagata *insert* ola (life).

„ „ „ „ „ tangata *insert* oranga (life).

„ „ „ „ he kanaka *insert* ke-*ola*-ana (life).

„ line 17, *for* There is no *read* By conversion there is close.

„ line 18, *after* word *insert* man being *life*.

„ line 22, *after* Malay *insert* and (by conversion) of Samoan, Maori, and Hawaiian.

231, line 19, *for* Takha *read* Yakha.

235, last line, *for* 235 *read* 252.

236, line 1, *for* 496 *read* 513.

240, in the fourth column, line 14, *after* idup, Malay *insert* bula, Fijian

245, line 24, *for* Ziphius *read* Epiodon.

272, line 2 from below, and 273, line 1, *for* Declava *read* Declana.

281, line 15, *for* Asteriseus *read* Asteriscus.

282, line 19, *for* Ophiarachna *read* Ophiorachna.

291, line 7, *for* Aphidæ *read* Cicadidæ.

294, line 3, *for* hairy *read* double.

360, line 26, *for* thyssoid *read* thyrsoid.

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NEW ZEALAND INSTITUTE.

ESTABLISHED UNDER AN ACT OF THE GENERAL ASSEMBLY OF NEW ZEALAND, INTITULED "THE NEW ZEALAND INSTITUTE ACT, 1867."

BOARD OF GOVERNORS.

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His Excellency the Governor. | The Hon. the Colonial Secretary.

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1880.—Captain W. R. Russell, M.H.R., W. L. Buller, C.M.G., Sc.D., F.R.S., Thomas Kirk, F.L.S.

MANAGER.

James Hector.

HONORARY TREASURER.

The Ven. Archdeacon Stock.

SECRETARY.

R. B. Gore.

ABSTRACTS OF RULES AND STATUTES.

GAZETTED IN THE "NEW ZEALAND GAZETTE," 9 MARCH, 1868.

SECTION I.

Incorporation of Societies.

1. No Society shall be incorporated with the Institute under the provisions of "The New Zealand Institute Act, 1867," unless such Society shall consist of not less than twenty-five members, subscribing in the aggregate a sum of not less than fifty pounds sterling annually, for the promotion of art, science, or such other branch of knowledge for which it is associated, to be from time to time certified to the satisfaction of the Board of Governors of the Institute by the Chairman for the time being of the Society.

2. Any Society incorporated as aforesaid shall cease to be incorporated with the Institute in case the number of the members of the said Society shall at any time become less than twenty-five, or the amount of money annually subscribed by such members shall at any time be less than £50.

3. The bye-laws of every Society to be incorporated as aforesaid shall provide for the expenditure of not less than one-third of its annual revenue in or towards the formation or support of some local public Museum or Library; or otherwise shall provide for the contribution of not less than one-sixth of its said revenue towards the extension and maintenance of the Museum and Library of the New Zealand Institute.

4. Any Society incorporated as aforesaid which shall in any one year fail to expend the proportion of revenue affixed in manner provided by Rule 3 aforesaid, shall from thenceforth cease to be incorporated with the Institute.

5. All papers read before any Society for the time being incorporated with the Institute, shall be deemed to be communications to the Institute, and may then be published as proceedings or transactions of the Institute, subject to the following regulations of the Board of the Institute regarding publications:—

Regulations regarding Publications.

(*a.*) The publications of the Institute shall consist of a current abstract of the proceedings of the Societies for the time being incorporated with the Institute, to be intituled, "Proceedings of the New Zealand Institute," and of transactions comprising papers read before the Incorporated Societies (subject, however, to selection as hereinafter mentioned), to be intituled, "Transactions of the New Zealand Institute."

(*b.*) The Institute shall have power to reject any papers read before any of the Incorporated Societies.

(*c.*) Papers so rejected will be returned to the Society before which they were read.

(*d.*) A proportional contribution may be required from each Society towards the cost of publishing the Proceedings and Transactions of the Institute.

(*e.*) Each Incorporated Society will be entitled to receive a *proportional* number of copies of the Proceedings and Transactions of the Institute, to be from time to time fixed by the Board of Governors.

(*f.*) Extra copies will be issued to any of the members of Incorporated Societies at the cost price of publication.

6. All property accumulated by or with funds derived from Incorporated Societies and placed in the charge of the Institute, shall be vested in the Institute, and be used and applied at the discretion of the Board of Governors for public advantage, in like manner with any other of the property of the Institute.

7. Subject to "The New Zealand Institute Act, 1867," and to the foregoing rules, all Societies incorporated with the Institute shall be entitled to retain or alter their own form of constitution and the bye-laws for their own management, and shall conduct their own affairs.

8. Upon application signed by the Chairman and countersigned by the Secretary of any Society, accompanied by the certificate required under Rule No. 1, a certificate of incorporation will be granted under the Seal of the Institute, and will remain in force as long as the foregoing rules of the Institute are complied with by the Society.

Section II.

For the Management of the Property of the Institute.

9. All donations by Societies, Public Departments, or Private Individuals, to the Museum of the Institute, shall be acknowledged by a printed form of receipt, and shall be duly entered in the books of the Institute provided for that purpose, and shall then be dealt with as the Board of Governors may direct.

10. Deposits of articles for the Museum may be accepted by the Institute, subject to a fortnight's notice of removal to be given either by the owner of the articles or by the Manager of the Institute, and such deposits shall be duly entered in a separate catalogue.

11. Books relating to Natural Science may be deposited in the Library of the Institute, subject to the following conditions:—

(*a.*) Such books are not to be withdrawn by the owner under six months' notice, if such notice shall be required by the Board of Governors.

(*b*.) Any funds specially expended on binding and preserving such deposited books, at the request of the depositor, shall be charged against the books, and must be refunded to the Institute before their withdrawal, always subject to special arrangements made with the Board of Governors at the time of deposit.

(*c*.) No books deposited in the Library of the Institute shall be removed for temporary use except on the written authority or receipt of the owner, and then only for a period not exceeding seven days at any one time.

12. All books in the Library of the Institute shall be duly entered in a catalogue which shall be accessible to the public.

13. The public shall be admitted to the use of the Museum and Library, subject to bye-laws to be framed by the Board.

Section III.

14. The Laboratory shall, for the time being, be and remain under the exclusive management of the Manager of the Institute.

Section IV.

Of Date 23rd September, 1870.

Honorary Members.

Whereas the rules of the Societies incorporated under the New Zealand Institute Act provide for the election of Honorary Members of such Societies; but inasmuch as such Honorary Members would not thereby become members of the New Zealand Institute, and whereas it is expedient to make provision for the election of Honorary Members of the New Zealand Institute, it is hereby declared—

1st. Each Incorporated Society may, in the month of November next, nominate for election as Honorary Members of the New Zealand Institute three persons, and in the month of November in each succeeding year one person, not residing in the colony.

2nd. The names, descriptions, and addresses of persons so nominated, together with the grounds on which their election as Honorary Members is recommended, shall be forthwith forwarded to the Manager of the New Zealand Institute, and shall by him be submitted to the Governors at the next succeeding meeting.

3rd. From the persons so nominated, the Governors may select in the first year not more than nine, and in each succeeding year not more than three, who shall from thenceforth be Honorary Members of the New Zealand Institute, provided that the total number of Honorary Members shall not exceed thirty.

LIST OF INCORPORATED SOCIETIES.

NAME OF SOCIETY.	DATE OF INCORPORATION.
Wellington Philosophical Society - - -	10th June, 1868.
Auckland Institute - - - - - - -	10th June, 1868.
Philosophical Institute of Canterbury - -	22nd October, 1868.
Otago Institute - - - - - - -	18th October, 1869.
Westland Institute - - - - - -	21st December, 1874.
Hawke's Bay Philosophical Institute - - -	31st March, 1875.

WELLINGTON PHILOSOPHICAL SOCIETY.

Office-bearers for 1879 :—*President*—A. K. Newman, M.B., M.R.C.P. ; *Vice-presidents*—Dr. Hector, Martin Chapman ; *Council*—W. L. Buller, C.M.G., Sc.D., etc., C. R. Marten, F. W. Frankland, S. H. Cox, F.C.S., F.G.S., Hon. G. Randall Johnson, W. T. L. Travers, F.G.S., T. Kirk, F.L.S. ; *Auditor*—Arthur Baker ; *Secretary and Treasurer*—R. B. Gore.

Office-bearers for 1880 :—*President*—Martin Chapman ; *Vice-presidents*—Dr. Hector, C.M.G., F.R.S., Dr. Buller, C.M.G., F.R.S. ;—*Council*—F. W. Frankland, S. H. Cox, F.G.S., F.C.S., Hon. G. Randall Johnson, M.L.C., W. T. L. Travers, F.L.S., A. K. Newman, M.B., M.R.C.P., J. P. Maxwell, A.I.C.E. ; *Auditor*—Arthur Baker ; *Secretary and Treasurer*—R. B. Gore.

Extracts from the Rules of the Wellington Philosophical Society.

5. Every member shall contribute annually to the funds of the Society the sum of one guinea.

6. The annual contribution shall be due on the first day of January in each year.

7. The sum of ten pounds may be paid at any time as a composition for life of the ordinary annual payment.

14. The time and place of the General Meetings of members of the Society shall be fixed by the Council and duly announced by the Secretary.

AUCKLAND INSTITUTE.

Office-bearers for 1879:—*President*—Rev. A. G. Purchas, M.R.C.S.E.; *Council*—R. C. Barstow, Rev. J. Bates, J. L. Campbell, M.D., J. C. Firth, His Honour Mr. Justice Gillies, T. Heale, Hon. Col. Haultain, G. M. Mitford, J. Stewart, M. Inst. C.E., T. F. S. Tinne, F. Whitaker; *Auditor*—T. Macffarlane; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S.

Office-bearers for 1880:—*President*—F. D. Fenton; *Council*—G. Aickin, Rev. J. Bates, J. L. Campbell, M.D., J. C. Firth, Hon. Col. Haultain, Neil Heath, F.G.S., E. A. Mackechnie, J. A. Pond, Rev. Dr. Purchas, J. Stewart, M. Inst. C.E., S. P. Smith; *Auditor*—T. Macffarlane; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S.

Extracts from the Rules of the Auckland Institute.

1. Any person desiring to become a member of the Institute, shall be proposed in writing by two members, and shall be ballotted for at the next meeting of the Council.

4. New members on election to pay one guinea entrance fee, in addition to the annual subscription of one guinea, the annual subscriptions being payable in advance on the first day of April for the then current year.

5. Members may at any time become life-members by one payment of ten pounds ten shillings, in lieu of future annual subscriptions.

10. Annual General Meeting of the Society on the third Monday of February in each year. Ordinary Business Meetings are called by the Council from time to time.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

Office-bearers for 1879:—*President*—Professor Bickerton; *Vice-presidents*—J. Inglis, R. W. Fereday; *Council*—Rev. J. W. Stack, Professor Cook, Dr. Powell, Professor von Haast, F.R.S., Dr. Coward, G. W. Hall; *Hon. Treasurer*—W. M. Maskell; *Hon. Secretary*—J. S. Guthrie.

Office-bearers for 1880:—*President*—E. Dobson, C.E.; *Vice-presidents*—Professor Julius von Haast, F.R.S., the Rev. J. W. Stack; *Council*—Professor Bickerton, R. W. Fereday, J. Inglis, A. D. Dobson, G. Gray, J. S. Lambert; *Hon. Treasurer*—W. M. Maskell; *Hon. Secretary*—Nelson K. Cherrill.

Extracts from the Rules of the Philosophical Institute of Canterbury.

21. The Ordinary Meetings of the Institute shall be held on the first Thursday of each month during the months from March to November inclusive.

35. Members of the Institute shall pay one guinea annually as a subscription to the funds of the Institute. The subscription shall be due on the first of November in every year. Any member whose subscription shall be twelve months in arrears, shall cease to be a member of the Institute, but he may be restored by the Council if it sees fit.

37. Members may compound for all annual subscriptions of the current and future years by paying ten guineas.

OTAGO INSTITUTE.

Office-bearers for 1879:—*President*—Professor Hutton; *Vice-presidents*—W. N. Blair, C.E., Professor Scott; *Council*—W. Arthur, C.E., Robert Gillies, F.L.S., Dr. Hocken, A. Montgomery, D. Petrie, J. C. Thomson, Professor Ulrich; *Hon. Secretary*—Geo. M. Thomson; *Hon. Treasurer*—H. Skey; *Auditor*—J. S. Webb.

Office-bearers for 1880:—*President*—Dr. Hocken; *Vice-presidents*—Professor Ulrich, D. Petrie, M.A.; *Council*—W. Arthur, C.E., W. N. Blair, C.E., A. Montgomery, R. Gillies, F.L.S., W. Macdonald, LL.D., Bishop Nevill, D.D., J. S. Webb; *Hon. Secretary*—Geo. M. Thomson; *Hon. Treasurer*—H. Skey; *Auditor*—D. Brent, M.A.

Extracts from the Constitution and Rules of the Otago Institute.

2. Any person desiring to join the Society may be elected by ballot, on being proposed in writing at any meeting of the Council or Society by two members, on payment of the annual subscription of one guinea for the year then current.

5. Members may at any time become life-members by one payment of ten pounds and ten shillings, in lieu of future annual subscriptions.

8. An Annual General Meeting of the members of the Society shall be held in January in each year, at which meeting not less than ten members must be present, otherwise the meeting shall be adjourned by the members present from time to time, until the requisite number of members is present.

(5.) The session of the Otago Institute shall be during the winter months, from May to October, both inclusive.

WESTLAND INSTITUTE.

Office-bearers for 1879:—*President*—His Honour Judge Weston; *Vice-president*—R. C. Reid; *Committee*—Dr. James, Dr. Giles, James Pearson, R. W. Wade, E. B. Dixon, John Nicholson, H. L. Robinson, D. McDonald, W. D. Campbell, Robert Walker, A. H. King, T. O. W. Croft; *Hon. Treasurer*—W. A. Spence; *Secretary*—John Anderson.

Office-bearers for 1880:—*President*—His Honour Judge Weston; *Vice-president*—Dr. Giles, R.M.; *Committee*—Dr. James, J. Pearson, J. Nicholson, H. L. Robinson, R. W. Wade, D. McDonald, J. Anderson, T. O. W. Croft, C. E. Tempest, F. A. Learmonth, J. H. Hankins, A. H. King; *Hon. Treasurer*—W. A. Spence; *Secretary*—Richard Hilldrup.

Extracts from the Rules of the Westland Institute.

3. The Institute shall consist:—(1) Of life-members, *i.e.*, persons who have at any one time made a donation to the Institute of ten pounds ten shillings or upwards; or persons who, in reward of special services rendered to the Institute, have been unanimously elected as such by the Committee or at the general half-yearly meeting. (2) Of members who pay two pounds two shillings each year. (3.) Of members paying smaller sums, not less than ten shillings.

5. The Institute shall hold a half-yearly meeting on the third Monday in the months of December and June.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

Office-bearers for 1879:—*President*—The Right Rev. the Bishop of Waiapu; *Vice-president*—W. I. Spencer; *Council*—E. H. Bold, W. Colenso, J. G. Kinross, S. Locke, M. R. Miller, J. A. Smith, F. W. C. Sturm; *Hon. Secretary and Treasurer*—W. Colenso; *Auditor*—T. K. Newton.

Office-bearers for 1880:—*President*—The Right Rev. the Bishop of Waiapu; *Vice-president*—W. I. Spencer; *Council*—H. Baker, E. H. Bold, W. Colenso, H. R. Holder, J. G. Kinross, M. R. Miller, F. W. C. Sturm; *Hon. Secretary and Treasurer*—W. Colenso; *Auditor*—T. K. Newton.

Extracts from the Rules of the Hawke's Bay Philosophical Institute.

3. The annual subscription for each member shall be one guinea, payable in advance, on the first day of January in every year.

4. Members may at any time become life-members by one payment of ten pounds ten shillings in lieu of future annual subscriptions.

(4.) The session of the Hawke's Bay Philosophical Institute shall be during the winter months from May to October, both inclusive; and general meetings shall be held on the second Monday in each of those six months, at 8 p.m.

TRANSACTIONS.

TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE,

1879.

I.—MISCELLANEOUS.

Art. I.—*The Forest Question in New Zealand.* By A. Lecoy, M.A., LL.B. Univ. Paris.

[*Read before the Wellington Philosophical Society*, 26*th July*, 1879.]

Introduction.

I. Statistics
II. Premises.
III. State Forests.
IV. Revenue derivable.
V. Revenue in Europe.
VI. Estimated Revenue for New Zealand.
VII. Scheme of Management.
VIII. Value of Timbers.

Introduction.

Among the various systems already adopted for the purpose of turning to profit the natural resources of the public estate, stands prominently what is called the Public Works policy. This was a broad and bold enterprise, involving future rather than present advantages. Therefore, the time for us to fully appreciate the merits of that policy has not yet come, and what seems desirable to be done in the interval, would be, to avoid the locomotive crossing the path of the chariot of the State; for our attention may be called to the facts, that the incessant progress of the colony will have the effect of increasing the State expenditure, and that such increase may be required before an adequate augmentation of the revenue is available.

Parallel with the Public Works system might be initiated a new policy, tending to promote the interest of the Colonial Treasury, by improving and consolidating, instead of exhausting, the revenue derivable from the public estate, by a systematic treatment of the Crown forest lands, which revenue might be increased to such an amount as to provide at any time for the largest portion of the expenditure required for general State

purposes. Had measures in that direction been carried out ten years ago, when in the House of Representatives Mr. Potts moved, "That it is desirable Government should take steps to ascertain the present condition of the forests of the colony, with a view to their better conservation;"—had the forest question been then more practically investigated and considered in all its aspects, especially in that of the income which State forests, under systematic treatment, can afford to the public purse, without either their climatic advantages being disturbed through the fellings, nor the supply being reduced below the demand, as evidently would have been (and still would be) the case in New Zealand—we might have had by this time the same extent of railways, less a heavy indebtedness, and also fewer alienations of valuable timber lands. Furthermore, we should have now a surplus income, which fund would afford a means for a more equitable distribution of the public revenue towards municipal interests than the present allotment of lands for such purposes can allow.

The Government may yet be in time to recur to such a policy, and there are facts demanding their immediate consideration of the question. Thus, the probable duration of the financial resources at present derivable from the sales of the forest lands requires serious attention. If we compute the total area of the Crown forests, which may be accessible and available for absolute disposal, we shall find that it could hardly comprehend more than one-eighth part of the area of the whole estate, officially stated, in 1877, as 29,000,000 acres, valued at £16,000,000. Then, by selling yearly those forests to the amount of £400,000 or £500,000, with the addition, meanwhile, of the land grants, endowments, etc., and also adding the value of destruction perpetrated on the leased forests, it becomes evident that these operations, if continued, will, in the course of a few years, completely alienate the most valuable portion of the public estate. Thereby a source of State income, by nature made lasting and abundant, will be dried up for ever. The alienated forest will gradually disappear under the exigences of individual interest, which demand more immediate returns for labour or capital than the conservation of forest lands can afford, and the destruction of the forest areas will lead to disasters resulting from floods and droughts, which will be severely felt by the Colony.

However, the State expenditure must be provided for through the ways and means allowed by the Legislature; and the purport of this paper is simply a humble attempt to ascertain, so far as data and information at hand will permit, whether the material interest of the Colonial Treasury, as well as that of the country at large, may not be further promoted through the establishment of State forests than by the temporary financial resources derivable from the forest alienations.

I.—Statistics.

The following total quantities relating to the area and value of the Crown lands have been compiled from the Survey Department returns, dated 17th of October, 1877, entitled "Statement showing the area and approximate value of the * unsold land in each County in New Zealand, on 31st of August, 1877" :—

Area and Approximate Value of the Colonial Estate on 31st August, 1877.

Situation.	Forest Land.	Open Land.	Total Area.	Approximate Value.
	Acres.	Acres.	Acres.	£
In the North Island	3,801,612	776,706	4,578,318	2,784,148
,, South Island	3,717,220	17,295,284	21,012,504	13,236,852
,, Stewart Island ..	393,000	22,000	415,000	58,125
Mountainous or valueless (South Island)	..	..	3,336,026	..
Totals	7,911,832	18,093,990	29,341,848	£16,079,125

The official statement does not give the area of the open land in the counties of Wairoa, Hawke Bay, Wanganui, East Taupo, Rangitikei, Manawatu, Waipawa, Hutt, Wairarapa East and West, Raglan, and West Taupo (North Island).

Forest lands inserted in the columns agricultural and pastoral, have been included in the column *forest land* in the above table.

II.—Premises.

A careful observation of the distinct interests which the colonial estate comprehends, points out of itself, as specially relating to the improvement of the resources derivable therefrom, the advisability of a separate management applying to the open lands and to the forest lands respectively, each kind of property, whether it be intended for sale or conservation, requiring special treatment under the supervision of officials of special aptitude in their respective departments. On the one hand, agronomists are required for the purpose of rendering the soil and climate of vast and treeless regions better adapted to settlement; whilst, on the other hand, foresters are needed to supervise the conservation of State forests, creating thereby a permanent State revenue.

The adoption of a new system for the general administration of the public estate may partly depend on some preceding legislative action. Still, so far as the forest interest is concerned, it does not appear that there should be immediate need for any changes in the existing forest legislation, otherwise than by appropriating the necessary fund to the creation of the special department.

* App. to Journ. H. of R., 1877, C—9.

The State Forests Act of 1874, and likewise the Land Act of 1877 (part V.), provide for the establishment of State forests, allowing Government full power to carry their objects into operation.

The enactments of the forest law have not, however, hitherto been carried into execution, and it is still generally presumed that there is a superabundance of forest produce for the present and future requirements of the colony—such an opinion not being at all supported by any reliable data or technical statement. Thus, the whole subject being restricted to the single observation of the presumed yield of the forests taken comparatively with the amount of the present home consumption, other considerations of high importance bearing on the subject are overlooked, namely—

1. That the demand for forest produce, annually supplied out of the public estate, has already attained such proportions that a considerable State income should be actually derivable therefrom.

2. That the New Zealand timber, "*sui generis*" in the world, and generally superior in economic value and fineness to any timber indigenous or imported to Europe, commands an export trade there on a large scale, especially on account of the perfect adaptability of several of its species to various purposes of the European requirements, and that a considerable State income may also be realized through a special export duty, intended for the two-fold object of providing for the legitimate rights of the public purse, and also of maintaining the price of timber for home consumption within moderate bounds.

3. That the progress of the colony, as well as the extension of the timber exports, cannot fail, within a short period of years, to increase the demand for our forest produce to such an extent as to require the full capability, *technically determined and regulated*, of the New Zealand forests to supply the said increased demand.

Should a new organization for the administration of the public estate have the effect of restricting the disposal of the forest lands to the sale of the standing timber, in such proportion as the forest could supply annually and permanently, and should also the system of leasing the forests be amended or done away with, the material advantages expected to result from those measures may be premised as follows:—

1. The well-regulated sales of the standing timber would afford a permanent State income amounting to much above the proceeds from the forest land under the present system of alienation and forest leasing.

2. This restriction would enhance the market value or revenue of the existing freehold property, the owners, of forest lands especially, not having any longer to complain of a competition so prejudicial to the value of their property as that resulting from the disposal of the public timber lands at nominal prices.

With respect to the leasing of the forest lands it may be asked—why should not any disposition of the Crown forest lands follow the same course as that applying to any other property? that is to say—why should such public property be disposed of otherwise than at a price representing its real value, so as to obtain the legitimate profit for the public purse?

The interest that the present bush licence or leasing system affords to the State is "nil." To the public it affords timber and wood on conditions more or less advantageous. On the other hand, the detrimental effects resulting from such leases are great:—First, the forest is generally worked indiscriminately, without any care for its regeneration, thereby effecting every year the absolute destruction of forests which had just yielded produce to the markets of enormous value.

On that score the lessee may say that it is not his business or duty to select and reserve trees which may be required for the purpose of securing the regeneration of the forest.

On the other side the public may argue that the law of the country having enacted as a principle that public forests "are to be subjected to skilled management and proper control," the actual destruction of the property through indiscriminate working cannot be considered lawful.

The period of years for which these leases are granted at almost nominal prices, would lead to the idea of an admitted permanent stagnation in the timber trade, which is not compatible with the fact of the incessant progress of the colony, otherwise the leases would constitute a monopoly of privileges, and thereby be an injustice to the people, who all have to contribute proportionately towards the State expenditure, and who are therefore entitled to claim the "*jus omnium in omnia.*"

However, all legitimate rights must be recognized and protected, and it is obvious that a new forest administration tending to extend the timber trade to an enlarged sphere of operations, would greatly benefit the lessees of our forests, and they, no doubt, would be glad to join in just and profitable reforms.

III.—State Forests: Preliminary Observation.

The establishment of State forests has for its object, not only to provide for a regular and permanent supply of timber and wood, but also to maintain the protection given by nature against the disturbance of the climatic equilibrium, the occurrence of droughts, the disastrous effects of flood-waters, etc., etc., experience having shown the preventive or modifying influence, as the case may be, of extensive forest areas. Furthermore, that the conservation of these woodlands, intended for the general interest, should not be entrusted to the management of private persons as purchasers of them, because forests, considered from a financial point of view, being almost

the least remunerative of all land cultivations (as private property), the apparent interest of the purchaser would be to realize the value of the timber, and to convert the forest land into agricultural or pastoral, thereby selfishly disregarding the beneficial effects which the existence of the forest afforded to the whole district.

In the hands of Governments, forests represent a national interest of the highest importance, not only because of the financial resources which the annual fellings afford, as the direct revenue derivable from the property, but above all, on account of the salubrious and fertilizing effects which forests bestow on the surrounding country, thus favouring the progress of agriculture, and the general development of national wealth.

It is only under such prosperous conditions, it may be remarked, that freehold lands can well afford to contribute towards the public expenditure, and thus will spring up, (*i.e.*, by the conservation of forests,) other sources of state revenue. Again, the great mass of the ever-growing forest, notwithstanding the annual thinning out of it, is also acting as a capital devoted to insure the welfare of agriculture, maintaining thereby the security of the public revenues as well as that of private property.

The material importance of these indirect advantages, as resulting from the proper management of forests, especially when situated in mountainous regions, may be demonstrated by the observation of events of recent occurrence in France. In that country, as the result of injudicious alienations of State forests, and the further conversion of the forest land into pasturages, originated periodical inundations, and the ultimate ruin of agriculture in no less than four "*Départements*," the rural population of which are now emigrating to America.* The loss of private property has thus been enormous, and the deficiency in the land tax revenue from the same cause, viz., the indiscriminate clearing of forests, may also be computed at millions of money.†

To the collateral advantages just alluded to may be ascribed the difference in character and productive value of forests, as State or freehold property respectively.

For climatic purposes, the total area of the Crown forest lands in New Zealand, taken at 5,000,000 acres, would not be more than sufficient as compared with the area of the whole colony; for the probability is, that the private forests at present adding to the climatic advantages of the public woodlands, will gradually disappear, unless the owners could be persuaded to sacrifice their own pecuniary interest to the public welfare. In France

* "Etudes sur l'Aménagement des Forêts," p. 489, par. L. Tassy, Conservateur des Forêts. Rothschild, publisher, Paris.

† The land tax revenue in France amounts to about £24,000,000.

and in Germany the primitive woodland areas, though much reduced, still represent in both countries a surface equal to about 24 per cent. of the total area of the country, but notwithstanding this the people there are complaining of climatic disturbances as the result of the clearing of the woodlands.

IV.—Revenue derivable from State Forests.

This most interesting part of the whole question has, it seems, been altogether misunderstood in this colony. Semi-official statements relating to the forest revenue in Germany, had the effect of representing the amount of the said revenue as not being above a few shillings per acre, from which a large amount of expenditure had to be deducted. Upon the admitted value of that source of information, it was resolved, in the House of Representatives, a few years ago, that, "judging from the results attained in Germany, the conservation or regeneration of the indigenous forests in this colony would not pay." * * * *

In the said statements the forest revenue, arising from the annual acreage of fellings, has been ascribed to the whole forest area, through an erroneous analogy between the productive value of high timber State forests and those of freehold property, but the dissimilarity in the respective conditions pertaining to each kind of property does not admit of comparison; besides which, the annual acreage being calculated on only a portion of the whole arboreal stock, it cannot be taken as the revenue or produce of the whole forest area. However, the essential point to be observed is the actual result or total amount of revenue derivable from State forests, when managed under such principles as are generally adopted in Europe. The item of the amount of expenditure involved in the management of those forests also requires consideration.

All State forests in Europe have been, and many are still, encumbered with forest rights and servitudes of feudal origin, the commutation of which, necessitates expenses generally included in the expenditure of the Forest Department; which, with other causes of expense, such as the preservation of game, the collection of the forest revenue, etc., etc., are in Germany also included in the departmental expenditure. In France, the Forest Department has nothing to do with the preservation of game, nor with financial matters; besides which all forest rights and servitudes have been redeemed, and the departmental expenditure is thus confined to the salaries of the staff and forest guards, and does not exceed five per cent. of the revenue; whilst in Germany, owing to causes just stated, the average forest expenditure in the German States hereafter named is above 30 per cent. On the other hand, as may be observed in the following tables, the gross returns from the annual sales of the standing timber have hitherto been less in France than in Germany, the

cause for such a difference being mainly that a systematic treatment of State forests had been adopted in Germany long before it was introduced into France, and that the revolution or age of maturity of forest trees having been fixed so high as 100 to 200 years, according to species, climate, soil, etc., forests in Germany yield at the present time a larger number of trees, arrived at maturity and full dimensions, than those of France, thereby affording larger money returns.

V.—Revenue of State Forests in Europe.

Return, showing: Column 1, the total area of State forests in each State; column 2, the annual acreage devoted to the fellings, as the computed total surface of the separate lots of ground where trees have been felled*; column 3, State income per sales of the standing timber, as the exhaustive product per column 2; column 4, income per acre, per column 2; column 5, amount of the departmental expenditure under actual circumstances special to each State; column 6, percentage of the expenditure on the revenue:—

Name of State.	1 Area.	2 Annual Acreage.	3 State Income, per column 2.	4 Income per Acre, per column 2.			5 Amount of Expenditure.	6 Per centage of Expenditure.
	Acres.	Acres.	£	£	s.	d.	£	Per cent.
Bavaria	3,000,000	24,000	1,261,279	52	11	0	494,287	39
Hanover	591,000	4,728	408,200	86	6	0	128,000	31
Saxony	3,94,000	3,152	350,000	114	6	0	101,000	29
Prussia	6,216,500	49,732	2,100,000	42	4	0	1,100,000	51
France	2,500,000	20,000	1,400,000	70	0	0	70,000	5

Remarks.—Columns 1, 3, 5, are taken from Captain Campbell-Walker's reports on the forests of the German States, and for France the information is taken from the official returns, including ten consecutive years, up to 1870.

For all of the above State forests, the average period of the revolution is taken as 125 years.

As a rule, the upset prices at the auction sales are calculated to allow one-third of the market value of the forest product as the share of the State.

In Europe, as the demand for forest produce exceeds the supply derivable from State forests, the greatest care is taken to ascertain the capability of those forests and so to allow about equal annual returns permanently.

* The working of high timber forests by thinnings, being intended to secure the natural regeneration of the forest, prevents at the same time the existence of large open spaces or blanks in the interior of the forest, which would prove fatal to the surrounding standing timber.

The capability in high timber forests is determined by estimating the cubic volume of the ligneous material of the whole area, then assigning it in calculated quantities to sections of the forest, which are worked in rotation.

The amount of the annual fellings in those forests does not, as a rule, exceed one per cent. of the timber contained in the whole forest. Such a percentage, however, represents a money value considerably above that derivable from any other land cultivation for the same acreage; and should the amount be considered as the revenue of the whole forest, it would then show a revenue about equal to that generally expected from arable lands, after deducting from the latter the cost or value of labour and other agricultural expenses.

By subjecting our indigenous forests to such a systematic treatment as may be actually practicable, the State revenue derivable from them should, in due course of time, become superior to that afforded by State forests in Europe, especially on account of the high value of the timber we could export.

VI.—Statement showing the Approximate Revenue available Two Years after Formation of the Forest Department.

1	2	3	4	5	6	7	8	9
(In 1881.)	(In 1881.)				(In 1881.)	(In 1881.)	(In 1881.)	(In 1881)
Total Area of valuable Forests in the hands of the Government.	Amount of the demand, including Home Consumption and Exports, per Annum.	Average Exhaustive Yield of the Forests, per 1 acre.	Total Annual Acreage required to supply the demand, as per column 2.	Area systematically required to allow the Annual Acreage, the period of the revolution taken on an average of 100 years.	Average Market Value of the whole product of 1 acre, By 9,000 superficial feet of first-class timber, average £1 per 100 £90 „ 12,000 feet of second-class timber, firewood, fencing, etc., as equal to superficial feet, averaging 10s. per per 100 ... ... £60 21,000 Superficial feet.	Receipts by annual sales of the standing timber and wood, for a quantity equal to 21,000 superficial feet, or per 1 acre yielding such a quantity.	State Income. £ By Annual sales 1,190,500 „ Export duty, as averaging for a period of 3 years (up at end of 1884), per annum, say ... 309,500	Amount of the Departmental Expenditure, and its permanent percentage on the Income to be 3 per cent.
Taken as	Taken as	Taken as						
Acres.	Superficial Feet.	Superficial Feet.	Acres.	Acres.				
5,000,000	500,000,000	21,000	23,810	2,381,000	£150	£50	£1,500,000	£45,000

Remarks.—Column 1: The taken area would be nearly double that required to supply the stated amount of the demand, but the actual surplus (2,619,000 acres) includes forests not yet accessible by roads or railways, and will soon be required in order to meet the sure increase of the present demand.

Column 2: In 1876, the demand for sawn timber alone, as computed on official returns, amounted to about 150,000,000 superficial feet. The interval between that year and 1881 will give a period of five years, for which the increase is taken approximately as 100,000,000 superficial feet, the surplus quantity being ascribed to firewood, fencing, etc. The exports to Europe are included for a quantity averaging 25,000,000 or 30,000,000 superficial feet per annum, from 1881 to the end of 1884. Altogether, the stated amount of the demand may be admitted as a minimum.

Column 3: No accurate information on the subject can be had before the Forest service be organized. However, the matter is not, at present, of material importance, for should the above stated yield per acre be above the mark, it will be possible to go afield on marking operations for the purpose of meeting the amount of the demand, and should the stated average yield prove to be under the mark, so much the better will it be for the interest of the State. Experiments for the purpose of ascertaining the average yield of our indigenous forests will have to be made in each block.

Column 3 is the basis on which must rest the whole system. The given yield per acre being divided by the amount of the demand, the quotient will show the number of acres required to supply the demand; then by multiplying the annual acreage by 100, as the supposed admitted age at which, or above which, trees will be felled, the area per column 5 is obtained. The surplus quantity of the area per column 1 to be reserved for future requirements.

Columns 6 and 7: The quotations apply to the year 1881. No exaggeration has been found in them by competent persons, to the consideration of whom they have been submitted.

Columns 8 and 9: The matter of the departmental expenditure and that of the exports is further considered.

VII.—MANAGEMENT OF STATE FORESTS IN NEW ZEALAND ACTUALLY PRACTICABLE.

The methods generally adopted in Europe for the purpose of determining the proportion of the annual fellings which forests can afford permanently, involve lengthy and complex operations, having to be performed by a special staff of trained forest officers. For that reason, among others, those methods are not at present wholly applicable to the colony. Meanwhile, and until the department be fully organized, a system of forest conservation not particularly requiring high technical attainments on the part of foresters on executive service, may be carried out with benefit.

The fact that the supply derivable from our State forests, even under technical rules, is for the present in excess of the demand, will allow, generally, that the extent of the annual fellings may be determined by the quantity in actual demand. Therefore, the approximate quantity of the demand being given, the forest officers will have to perform the following operations :—

(1.) To select and mark, on sections to be worked, trees to be reserved as may be required for the purpose of securing the natural regeneration of the forest. (2.) To brand with a different mark all the standing timber intended for sale, calculating at the same time the cubic volume of that product, and proceeding thus so far as necessary to provide the requisite quantity. (3.) To estimate the market value of the produce to be sold, upon which valuation upset prices will be determined. Official advertisements of the auction sales specify the number, species, approximate yield in cubic feet, and locality of the trees to be sold, also the special conditions of the sale, but the money valuation is not made known to the public. The foresters will then have to verify, supervise, and enforce the execution of the by-laws and special conditions of the sales.

It is not within the scope of this paper to enter into further details on forest operations, the purport of those just mentioned being to show that no extraordinary qualifications are required for foresters on executive service, and that for practical purposes a sufficiently efficient staff may be at once formed here, while forest schools would gradually fill up any deficiencies in the service.

The importance of the whole matter does not allow of half measures, and the following tables, being the explanation of the previously stated amount of the departmental expenditure, are intended to show the requirements of the forest service at the beginning :—

Central Administration.				Total Salaries.
1 Director-General				£ 600
3 Administrators, acting as general inspectors				1,200
Clerks				1,025
	Executive Service.			5,625 Inspectors
Total Area to be divided into 100 Ranges.	Inspectors.	Rangers.	Forest Guards.	11,800 Rangers
	25 Inspectors.	100 Rangers.	450 Guards.	24,750 Guards
	Circumscription. Four ranges. Three classes; salaries averaging £225.	Three or four classes; salaries averaging £118. Range extending over about 23,810 acres.	Salary, £55 (average); house, garden, and firewood provided for; civil pension (further mentioned).	£45,000
				For Forest Establishments.
Acres. 2,381,000				Say £10,000

Forest guards have to do special work on survey and demarcation operations, and likewise on selection and marking operations; they make forest roads and plantations; and besides their work of general supervision they may be called for special police or military service. In the above stated total number, 400 guards are intended for permanent residence and 50 as a flying brigade.

In reference to the item of civil pensions to be allowed to forest guards, it is necessary to explain that the suggestion as to its meaning and application is not in opposition to the principle on which civil pensions were abolished here. The institution, as it was constituted, involved the State in heavy liabilities without any actual compensation for the same, and also conferred privileges on a certain class of the people.

Civil pensions in almost all countries are constituted under the principle that the Government servants have to pay for the pension, by a percentage of say, five per cent. being deducted from the nominal salaries. Experience in some countries has proved that such a percentage allows considerable profit to the State, owing to various causes of forfeiture, such as premature death, dismissal, and voluntary resignation of functions; further, the reduction of the nominal salary may also be considered as a guarantee for the good of the service, the probability being that those who have paid for the pension will not risk their future means of subsistence, through neglect of their official duties.

The salaries of the forest guards being taken as from £50 to £60 per annum with house or barracks, firewood, garden, and paddock, will allow

of a living equal at the least to that of any other of the working classes. Still, with such earnings, it may be very hard for many of those people to save enough for the bread of old age. Forest guards, as the guardians of public property, must feel independent in the execution of their functions, and that independence would naturally arise from the fact that the fulfilment of their duty on all occasions will be the guarantee of their means of subsistence for life.

For the purpose of meeting the amount of expenditure required for the formation of the Forest Department, also for the good of the service and that of those it may concern, the following outlines of a scheme are submitted :—

1st. Creation of a colonial pension fund, or deferred life annuities, to be constituted under such principles :—

(1.) That the amount of the pension should not exceed £60.

(2.) That the amount of the monthly instalments towards the pension should be calculated to the effect that neither loss nor profit would accrue to the State.

(3.) That the subscription to a pension of £60 should be compulsory for all Government servants receiving a salary under £100 per annum, but to be free, up to or under the said amount, to the working classes of the community.

(4.) That the right to the pension should be acquired by 25 years of payment of the subscription, and the pensioner not being under 55 years of age.

Cases of forfeiture : Failing to pay the monthly instalments, premature death, judicial condemnations in criminal cases, dismissal from the Government service for non-fulfilment of duty, etc.

2nd. The creation of a civil pension fund applying to all Government servants receiving a salary of or above £100 per annum.—The subscriptions to be compulsory, five per cent. reduction on the salary, causes of forfeiture as above, adding the case of voluntary resignation of functions, amount of the pension half that of the salary, reversion of half the pension to the widow of the pensioner, 30 years of service and 60 years of age giving right to the pension.

The enactment of such institutions would create means more than sufficient to meet the expenditure of the forest department.

As regards a systematic treatment of our indigenous forests, some technical points of importance might be reserved without prejudice until the service had attained sufficient experience to decide upon such questions, as for instance that of determining the age of maturity of the various species of trees. Meanwhile an average age of 100 years may be fixed, so that no valuable timber under that age should be felled. On this subject it may be

remarked that the financial interest of States is not governed by the same principles as those of private individuals. Private individuals may derive interest or profit from the investment of capital, which as a rule States do not. Thus, private individuals are able to find their own pecuniary interest by selling trees on their estate as soon as they attain marketable dimensions even before maturity, because the cash realized by the sale is expected to increase, through interest or profit, to such an amount as to be far above the value of the trees at the time of their maturity. States, as a rule, have no capital to invest at interest or otherwise; their receipts go to pay their expenditure, and so far as the revenue is derivable from State forests the larger amount of money the standing timber will reach at the auction sales the better it will be for the public purse. The fact that a full-grown tree is worth more money than one of less dimensions, need not be mentioned (particularly old trees of high value for the manufacture of furniture, etc).

Therefore, whilst the State is in possession of a stock of old trees more than sufficient to supply the demand, the present as well as the future interest of the Treasury will be found in the application of the rule, that trees should not be felled before full maturity. "*Arbores magnæ diù crescunt.*"

VIII.—Economic and Commercial Values of New Zealand Timbers.

Experiments for ascertaining the intrinsic value of New Zealand timbers were most carefully and skilfully made eighteen years ago, in Dunedin, under the direction of the late Mr. Balfour, C.E.; also, as a means for comparison, tables showing the values of European timbers, experimented on by Mr. Barlow, were prepared by the same talented engineer.

Preparatory to the consideration of the value of New Zealand timbers in European markets, the following statements, abstracted from Mr. Balfour's reports, are submitted, and will render it unnecessary to state the results of personal investigations, leading, as they do, to the same opinion as expressed by the late Mr. Balfour, viz., "That the New Zealand woods compared very fairly with those we have been accustomed to consider as standards, the absolute strength of very many being above that of the British oak."

COMPARATIVE TABLES OF THE INTRINSIC VALUES OF EUROPEAN AND NEW ZEALAND TIMBERS.

EUROPEAN TIMBERS.

NAME.	Strength or Strain the Wood can bear without Fracture.	Elasticity.	Weight, per cubic foot.	Remarks.
	lbs.		lbs.	
Oak (Great Britain) ..	128·55	127·01	55·96	General mean of all experiments.
" " ..	178·66	111·03	46·87	Special case.
Beach " ..	129·66	195·83	43·37	
Ash " ..	169·2	180·07	46·195	
Elm " ..	87·92	82·22	34·21	
Memel Deal	144·25	116	36·77	
Riga Fir	89·96	167·77	46·46	

NEW ZEALAND TIMBERS.

NAME.		Strength or Strain the Wood can bear without Fracture.	Elasticity.	Weight, per cubic foot.
		lbs.		lbs.
Black Maire	*Olea apetala*	314·2	273	72·29
Titoki	*Alectryon excelsum*	248	229	57·10
Black Mapau	*Myrsine australis*	243	215·2	60·14
Manuka	*Leptospermum ericoides*	239	239	59
Kowai	*Sophora tetraptera*	207·5	198·5	55·11
Tawa	*Nesodaphne tawa*	224	204·5	49·85
Towai (Black Birch, Otago)	*Fagus fusca*	232	214·05	44·42
Towai (Black Birch, Wellington)	"	199	209·3	50·96
Miro	*Podocarpus spicata*	197·2	230·24	49·07
Rata	*Metrosideros robusta*	217	214·02	60·10
Matai	*Podocarpus ferruginea*	190	156·22	42·74
Maire	*Eugenia maire*	179·7	177·2	49·24
White Mapeui	*Carpodetus serratus*	177·6	166·80	51·24
Kauri	*Dammara australis*	180·96	194·41	38·96
Rewarewa	*Knightia excelsa*	161	199·29	48·92
Red Birch	*Fagus menziesii*	158·2	116	39
Rimu (Wellington)	*Dacrydium cupressinum*	168	174·4	38
" (Hawke Bay)	" "	163	136·7	37·63
" (Dunedin)	" "	108	124·3	36·28
" (Canterbury)	" "	66	89·16	47·34
Totara (Hawke Bay)	*Podocarpus totara*	148	113·99	34·13
" (Wellington)	" "	140	163·8	33·83
" (Canterbury)	" "	121	94·74	36·16
Hinau	*Elæocarpus dentatus*	125	200·7	35·03
White Pine	*Podocarpus dacrydioides*	136	155	31·55

Several species of New Zealand timbers were not tested at the Dunedin experiments, such as puriri and manuao, or Westland pine, which are the strongest and most durable timbers in the colony.

Irrespective of the economic values just stated, many descriptions of New Zealand indigenous trees possess remarkable beauty in grain, mark-

ings, and varied tints, which would prove of high commercial value in Europe. For the purpose of exportation to Europe, New Zealand timbers may be divided into three classes:—

The first class to include timbers well adapted for the manufacture of furniture, cabinet work, etc., such as rewarewa, which, by lapse of time, assumes an extreme beauty, and the appearance of tortoise-shell. Then maire comes in for a more serious style of furniture, superior in beauty to old oak. Next we have all the varieties of waved and mottled kauri, rimu, totara, etc., all of exquisite beauty, far exceeding that of any wood known in Europe.

The second class to include timbers well adapted for ornamental works, where the adequate strength of the wood is required, such as inlaid floorings, when they are intended for ornamentation, panels, etc., for which rimu is prominently a suitable timber.

The third class to include timbers intended to supply the place of oak in its special uses, the scarcity and high commercial value of that timber being much felt in all European markets at the present time. The cause of the diminishing supply of oak and other hardwoods in Europe may be partly ascribed to the extension of railways, but principally to the progressive exhaustion of the product in countries where forest conservation is not carried out. Thus, from scarcity of those timbers, and high prices for the same, originated the introduction of iron ship-building, and also, so far as practicable, the more general adaptation of light woods to various building purposes. Oak however, cannot be replaced by iron or light wood in its essential uses; and in the many descriptions of New Zealand strong timbers will be found the requisite qualities to supply the place of that standard timber in Europe, in each of its special uses.

The principal outlets for the exchange of our forest produce should be England and France.

England is anxiously looking to her colonies for the supply of her enormous consumption of timber and wood, which, according to a recent statement taken from *The Economist*, represents a yearly value of £170,000,000. Canada contributes, for a value of about £5,000,000 per annum, towards these excessive requirements.* But forests in the Dominion are given up to waste and devastation, no effectual steps being taken to prevent their ultimate destruction, and hardwood is fast disappearing in all its provinces.

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* During five years ending 1876, Canada exported to the United Kingdom—

Timber and wood, to a total value of	£24,633,226
Corn and grain	16,536,983

(Colonial Timbers, Colonial Office, England.)

An analysis of returns relating to colonial timber, issued by the English Colonial Office, and presented to both Houses of Parliament, August, 1878, affords important information. In the prefatory observations of the official document it is stated that "*The returns exhibit, in a striking manner, the urgent need for some prompt and comprehensive action to stay the influences at work to destroy the indigenous forests which constitute, in many instances, the principal natural riches of the colonies.—Looking * * * above all, to the intrinsic importance of the question itself, this may be regarded as a matter of Imperial concern, calling for well-considered action on the part of the Government.*"

In the chapter devoted to New Zealand, the provisions of the State Forests Act of 1874 are recited, and the following remarks occur :—"*As a practical and comprehensive experiment in the direction of forest conservancy, the results will be looked forward to with interest.*" * * *

Besides the supply derivable from her dependencies, England imports immense quantities of timber from the north of Europe. But there, also, forests are becoming exhausted, and protective duties on the Baltic timbers are imminent.

The demand for staves and hardwood intended for various purposes, is considerable in the English markets, and should New Zealand timbers be better known there, they would soon be in demand to any amount that could be supplied. The same remarks apply to those of our woods which are so well adapted for the mannfacture of furniture, cabinet work, etc. However, for ordinary house-building purposes New Zealand timbers could not compete in price with the lighter woods generally used in England.

In France, the use of hardwoods for house-building purposes is more general than in England, and it may be there a matter of necessity, to which, in some cases, ornamentation is added. Houses in Paris being five stories high (each house affording habitation to ten families), have to be constructed with the strongest materials. Oak, as a rule, is used in the construction of stairs, inlaid floorings, doors, and panels, the work being finished off by the application of a special encaustic, which produces a varnish-like appearance. Thus, in France, oak is found to be both useful and ornamental; and floorings of polished oak are almost universal, carpets being but seldom used, and then only in winter. Another characteristic of French custom is extreme luxury in furniture, all classes of the people in towns seeking to possess themselves of the best furniture that their means will admit of. It may therefore be confidently asserted that New Zealand timbers, for all purposes indicated in the above classification, will find a ready market in France.

In addition to the annual product of her 23,000,000 acres of forests (including State, communal, and private forests, all of which are subjected

to the prohibitions against clearing), France has annually to import hardwoods to the value of £8,000,000, mostly intended for the navy, wine-cask staves, and furniture. The merchant navy has not, as yet, any iron ships.

Prices for oak, in the Paris market, were quoted by the *Revue des Eaux et Forêts*, of the 5th October, 1878, as follows:—

In log.—Logs of 2 mètres in circumference or above, 160 francs = £6 8s. 0d. *per cubic mètre* = 1 cubic yard + 10 per cent.; the logs to be measured at the quarter girth if not squared. Logs from 1 to 2 mètres in circumference—80 francs = £3 4s. 0d.

Planks.—Lots of all lengths, breadths and depths, being piled, 150 francs = £6 per cubic *mètre.*

Planks called "*Entrevoux.*"—Breadth 10 inches, depth 1 inch, 5 francs = 4s. *per* 1 *superficial mètre* = 10 superficial feet nearly = 40s. per 100 superficial feet.

All other dimensions in the breadth and depth of planks are charged proportionately to the cubic volume of the "*Entrevoux.*" Oak planks are to be free from sap-wood. The cost of freight from New Zealand to England or France, may be computed at about 6s. per 100 superficial feet, on a regular trade being established.

The above quotations are those of the forest contractor for newly-cut wood, the timber merchant regulating the price of his goods according to the length of time he has kept them seasoning. It is not uncommon in France to see oak splitting and warping in its various uses, as may be particularly observed at the fourth and fifth floors of houses where a comparatively low rent necessitates the use of cheap wood. Also, in the first and second floors of the same houses, oak from the same forest may be seen perfectly sound, the difference arising from the more perfect seasoning.

The above given quotations for oak in the Paris market, relate to the variety of the species which is the most abundant in the forests of France, viz., the "*Quercus cerris,*" which is not so strong a timber as the "*Quercus pedunculata,*" or British oak. Therefore, Mr. Balfour's tables, taken as a means for comparison between New Zealand and England's indigenous timbers, may certainly also stand good in reference to the standard timber of France. Prices for oak and other hardwoods in England are about the same as, if not higher than, they are in the Paris market.

It may also be a matter of interest to observe that the most abundant species of New Zealand timbers are precisely those which will best suit the French markets. Such are rimu, birch, tawa, totara, etc.; not that rimu, for instance, could be expected to supply the place of oak in all its various uses but, that, for purposes such as those mentioned in the second section

of the above classification, this timber, it may be confidently asserted, would attain a commercial value above that of oak. Birch, tawa, etc., could also advantageously replace oak in many of its special and essential uses on the same level as to prices.

The market value of New Zealand timbers in the colony, as compared with that which they should reach in the European markets, can only be given as the result of personal observation, inquiries, etc.

HOME PRICES.		PRICES ABROAD.	
	Per 100 superficial feet.		Per 100 superficial feet.
1st class timbers, from ..	12s. to 21s.	1st class timbers, from ..	£3 10s. to £8 0s.
2nd ,, ,, ,, ..	7s. ,, 15s.	2nd ,, ,, ,, ..	£2 10s. ,, £3 10s.
3rd ,, ,, ,, ..	7s. ,, 15s.	3rd ,, ,, ,, ..	£2 0s. ,, £2 10s.

The prompt success of our timber export trade in Europe will mainly depend on proper discrimination as to the individual adaptability of the wood, and when its reputation is well established, there would be no fear of any diminution of the demand for it, nor of unsuccessful competition with identical timbers from any other parts of the world.

Although the merits of the Dunedin experiments cannot be contested, they may not be found of much advantage for the purpose of establishing abroad the reputation of New Zealand timbers. Experiments, to have the effect of comparing the intrinsic value of our timbers with that of any standard wood abroad, should be made in the country where a good market is expected to be found.

The difficulty to be encountered abroad for the sale of our forest produce will be this: The timber merchant may well admit the superior value of our timbers, and at the same time refrain from giving orders for it, on the ground that he has his own stock to dispose of; that he has no demand for rimu or puriri, and that he cannot undertake to make a reputation, and thus create a demand, for unknown timbers. The same objections will be repeated at every wholesale house where the timber may be offered for sale. Another side of the question is that, in order to secure its full success, the exportation of New Zealand timber should be undertaken on a large scale.

In France, a means may be found for at once establishing, on an indisputable ground, the reputation of New Zealand timbers. The "*Conservatoire des Arts et Metiérs*," at Paris, is a public institution of great European renown. Science, in its application to the industrial arts and agriculture, is there demonstrated by eminent professors. The establishment possesses an ample supply of apparatus and machinery of all kinds, water and steam power, etc., intended for the purpose of testing the merits or properties of any new process or natural product having a character of general interest.

The monthly *Gazette* of the institution affords publicity to the experiments, and these reports have a considerable importance (scientific and commercial) as having the sanction of unquestionable authority. Here the intervention of the Government of the colony may be required; for we do not know how far the request of private individuals, for such a purpose, might be liable to objection. But, if presented by the Government, the request, bearing a character of general interest, would be granted at once. The experiments at the "*Conservatoire*" having thus been promoted through Government action, all surrounding details should be carefully attended to by the Government agent, or, as it may be, by the representative of any intended colonial company, who would have the official reports of the experiments inserted in the leading journals, as well as in the press specially devoted to the timber trade, taking such an opportunity for making special mention of our ornamental woods. Then the time would come for obtaining large orders from Governments, railway companies, etc., likewise for taking orders from well-known houses for our ornamental and furniture woods, and the effect of the experiments would reflect favourably on all classes of New Zealand timbers.

Some difficulties, however, more apparent than real, may also be encountered here. There is an insuperable connection between the forest question itself and the timber exports. Thus, by introducing a systematic management of the public forests, the Government would show a due appreciation of the value of that portion of the natural riches of the colony, thereby stimulating private enterprise as regards the exportation of our timbers to Europe, also helping in the matter so far as Government action may go.

Considered solely from a financial point of view, the forest question in New Zealand will show to any competent person giving attention to it, that within a period of, say ten or fifteen years hence, a permanent State revenue, to the amount of from £3,000,000 to £4,000,000, should be derivable from the State forests, and that meanwhile capital, to about the same amount, would come yearly from abroad, as money derived from the timber exports.

The magnitude of the interests involved in the forest question in this colony comprehends many important points which will have to be elucidated by official investigation in order to enlist public confidence, which will lead to practical results. So far as the conservation of the forests is concerned, the subject has already been treated in the New Zealand Parliament with a remarkable display of talent and patriotism.

In 1868, the Parliamentary debates assumed a character of the highest interest. The motion of Mr. Potts, relative to the conservation of the forests of the colony, received its full development on the part of the pro-

moter himself, and was supported by distinguished members of the House. The information and suggestions contributed on the occasion by the speeches of Messrs. Travers, Stafford, O'Neill, and others, still bear the same force of argument at the present time.

In 1870, the forest question sprang up in the Select Committee on Colonial Industries. Men of science were called in and interrogated. In his reply to Mr. O'Neill, Dr. Hector, in a few words, threw a vivid light on the whole subject. He said:—

"The rapid destruction of the native forests I consider to be most wasteful, and as having the effect of rapidly reducing the natural resources of the country. It is not at all necessary that the forest should be completely removed in the way that it usually is, either for the purpose of agricultural settlement, or the obtaining of timber for mills, firewood, or fencing. The thinnings of the forest would be ample in most cases to supply all the latter wants. By carelessly opening up tracts of forest, and especially by the firing of dead forests, the young growth of trees which comes up to supply the place of the trees that are removed is wholly arrested, and in a short time the air and sun dry up the surface soil of good quality, which characterizes freshly-cleared bush-land, and it is washed away by the rains." * * *

In 1873, Mr. O'Neill moved "That, in the opinion of this House, it is expedient that proper steps be taken for the conservation of the forests throughout the colony, with which view it is resolved that a respectful address be transmitted to his Excellency the Governor, requesting that he may be pleased to appoint a Royal Commission to inquire into and report upon the State forests and the best means for securing their conservation."

Sir D. Maclean said: "This subject appeared to have been well considered by the honourable member * * * but all the Government could promise was to look into the matter during the recess, with the view of introducing a bill next session."

In 1874 the State Forests Act was passed, but its provisions as to the fund intended for the administration of the State forests have since been rescinded.

Since then the forest agitation has subsided, but the extermination of forests by fire and axe has not ceased. Meanwhile the Public Works policy has been developed, extensive lines of railways have already been completed, others are in progress of construction, many more will be asked for, and under all circumstances the Colonial Treasurer will be entitled to look to the proper management of the State forests as an important and hitherto untouched source of revenue.

Art. II.—*Influence of Forests on Climate and Rainfall.* By Frederick S. Peppercorne, Civil Engineer.

[*Read before the Hawke's Bay Philosophical Institute*, 14*th July*, 1879.]

No fact is better authenticated than that of the beneficial influence exerted by the presence of forests on the climate and rainfall of a country, and, on the other hand, of the injurious effects on both that is brought about by the destruction of forests, or by their absence.

In this way their destruction has often become a real calamity to a country, and has proved to be one of those errors which nothing can excuse, and which nothing but a resort to years of tree-planting, in order to replace the forests destroyed, can remedy. That this is not an exaggerated view to take of the subject, is shown when we know the evil effects produced in many countries by the denudation of their forests—one striking instance of which is to be found in Spain, the central regions of which, comprising the Castiles, part of Leon, Estremadura, and La Mancha, possess at present an execrable climate, although, in the times of the Roman occupation of Spain, these districts were noted for the fertility of their soil and for the amenity of their climate, so that the words, "*Nihil otiosum, nihil sterile in Hispania*," passed into a proverb. But, at present, as we are told by Sir A. Ford, "The denuded table-lands are exposed to the fierce suns of the summer and to the fiercer snows and winds of winter, while the bulk of the peninsula offers a picture of neglect and desolation, moral and physical, which it is painful to contemplate. Extensive steppes and plains are burnt up by the sun in summer, and swept by the icy winds in winter, while rain is so rare in the table-lands that the annual fall does not exceed nine inches, and there are districts upon which no shower descends for eight or nine months together. The face of the earth is tanned tawny, and baked into a veritable '*Terra-cotta*,' and everything seems dead and burnt, as on a funeral pile."

And yet, under the dominion of the Moors, the country blossomed like a rose, while now Spain is one of the droughtiest and poorest countries in Europe, and the ignorance and prejudices of the peasantry have completed the devastation of her forests which her Catholic monarchs commenced. Fortunately, however, for Spain, she now possesses some enlightened men who, having been able to trace the causes of the evil up to their true source, are setting to work to remedy it, and are impressing upon the Spanish Government the imperative necessity of replanting the mountain ranges as the only efficient method of combatting the drought and its attendant disasters. They show clearly that the demolition of the forests has operated most disastrously both upon the soil and climate; that springs and streams have dried up; that rain has ceased to fall at one period of the year when it is most wanted, and descends with great violence at other times. This

causes the surface-soil to be washed off the hills (which have been denuded of their timber) and carried into the valleys, from whence it is swept away by calamitous inundations into the sea.

The preservation of the forests of a country is, therefore, one of the first duties of an enlightened Government; for, as Professor Macarel, a French writer of some note, observes: "All the wants of life are closely related to their conservation: agriculture, architecture, and almost all the industries, seek therein their aliment and resources, which nothing can replace. Necessary as are the forests to the individual, they are not less so to the State; their existence is, of itself, of incalculable benefit to the countries that possess them, as well in the protection and feeding of the springs and rivers, as in their prevention against the washing away of the soil upon mountains, and in the beneficial and healthy influence which they exert upon the atmosphere. Large forests deaden and break the force of heavy winds that beat out the seeds and injure the growth of plants; they form reservoirs of moisture; they shelter the soil of the fields and upon hill-sides, where the rain-water, checked in its descent by the thousand obstacles they present by their roots and by the trunks of trees, has time to filter into the soil, and only finds its way by slow degrees to the rivers. They regulate, in a certain degree, the flow of the waters and the hygrometrical condition of the atmosphere, and their destruction accordingly increases the duration of droughts and gives rise to the injuries of inundations."

The truth of these observations admits of no doubt, and instances may be multiplied to prove their accuracy. Thus, the island of Cyprus was, in ancient times, famed for its fertility when its hills were covered with timber; but of late years, and since the denudation of her forests, the bare and thirsty soil seems, as it were, to repel the rain-bearing clouds, and the island has become the prey of periodic drought and disease. During the three consecutive years from 1859 to 1861, no rain fell at Cyprus, and the inhabitants migrated *en masse* to the adjacent shores of Syria. Malaria appears to have become chronic in the island; but since its recent occupation by the British, an extensive system of tree-planting has been commenced under the auspices of Sir Garnet Wolseley, who, in a recent letter to the First Lord of the Admiralty, writes: "I am now planting 20,000 *Eucalyptus* trees of one and two years' growth, and even supposing that one-half of these die, I shall have made a good start towards replenishing the island with timber."*

* All who have made themselves acquainted with the French colonization of Algeria, must admire the public spirit displayed during the last twenty years in respect to the "*reboisement*," or re-timbering of the country, chiefly with the *Eucalyptus globulus* and other varieties of this tree—a measure which has been found to be equally effective both on sanitary and economic grounds.

Again, the Island of St. Helena offers a striking example of the effects of forest denudation upon its climate and rainfall. When it was first discovered in 1502, the island was covered with timber, which in many instances came down to the water's edge, and innumerable rivulets heightened the verdure of the land. But, shortly after its colonization, the inhabitants went recklessly to work to destroy the trees, and this was followed by a succession of severe and destructive droughts; so that, all through the 18th century, there were almost periodical visitations of these scourges, occasioning ruinous losses of cattle and crops. The East India Company, however, having adopted energetic measures for the replanting of the island with the cluster pine and other hardy forest trees, the result has been that the annual rainfall has become equal to that of England, and that it is spread almost evenly over the year, while droughts are altogether unknown.

Similar effects have been recorded with respect to the Island of Mauritius, in which a steady diminution of the rainfall has taken place since the destruction of no less than 70,000 acres of forests, or about one-sixth of the entire area of the island. This work of destruction was accomplished in the ten years from 1852 to 1862, with the following results as reported by Mr. Meldrum, the Director of the Observatory at that island:—"In no former year of the period of fourteen years did such floods occur as in 1861 and 1866, or such severe droughts as in 1865 and 1866. Nor is this all; for the Mauritius, which was formerly a 'sanatorium' for British officers invalided in India, is subject to deadly epidemics, owing to the lowering of some lakes and the complete desiccation of others. Malaria has thus been generated, and cholera and fevers have followed. Latterly, however, an extensive system of tree-planting has been commenced, with the best results."

On this subject also, Dr. Hooker, in a letter to Lord Kimberley, who was at that time Secretary of State for the Colonies, wrote as follows:—"The mischief already done in Mauritius and various West Indian islands is so widely spread (being in some, indeed, irreparable), and the feeling of the colonists against any interference on the part of the Government is apt to be so determined, that I venture to press upon your lordship my own opinion as to the urgency of active steps being taken in the case of an island so beautiful, and at present so fertile, as Ceylon. I have lately received an account of the deterioration of the climate of some of the Leeward Islands, which affords a melancholy confirmation of what I have urged above. The contrast between neighbouring islands similarly situated is most striking, while the sad change which has befallen the smaller ones is, *without any doubt*, to be ascribed to human agency alone. It is recorded of these, that

in former times they were clothed with dense forests, and their oldest inhabitants remembered when the rains were abundant, and the hills and all uncultivated places were shaded by extensive groves. *The removal of the trees was certainly the cause of the evil.* The opening of the soil to the vertical sun rapidly dries up the moisture, and prevents the rain from sinking to the roots of plants. The rainy seasons in these climates are not continuous cloudy days, but successions of sudden showers, with the sun shining hot in the intervals. Without shade upon the surface the water is rapidly exhaled, and springs and streams diminish."

The opinion of so eminent a botanist as Dr. Hooker must be conclusive on this subject; and in the Report of the United States' Commissioner of Agriculture for 1871, there occurs the following passage:—"In Upper Egypt, the rains which, eighty years ago, were abundant, have ceased since the Arabs cut down the trees along the valley of the Nile towards Lybia and Arabia. A contrary effect has been produced in Lower Egypt from the extensive planting of trees by the Pasha. In Alexandria and Cairo, where rain was formerly a great rarity, it has, since that period, become more frequent."

Again, speaking of the State of New York, and of the lofty mountains amongst which its principal rivers take their rise, Professor Marsh says:—"Nature threw up those mountains, and clothed them with lofty woods, in order that they might serve as a reservoir to supply with perennial waters the thousand rivers and rills that are fed by the rains and the snows of the 'Adirondacks,' and as a screen for the fertile plains of the central counties, against the chilling blasts of the north wind, which meet no other barrier in their sweep from the Arctic Pole. The climate of Northern New York even now presents greater extremes of temperature than that of Southern France. During what is called the 'heated term,' the weather is almost tropical, and the deaths from sunstroke, even in the city of New York, which lies at the most southerly point of the State, may be reckoned by scores, while the winters have become of late years quite Siberian in their severity."

With regard to the felling of the Adirondack woods, and the effects thereof, Professor Marsh warns his countrymen that their destruction will render a wide-spread desolation inevitable, and he dwells on this point, because we are apt to think that America possesses exhaustless forests:—"Already (he says) the rivers which rise in that region flow with diminished currents in dry seasons, and with augmented volumes of water after heavy rains. They bring down larger quantities of sediment; and the increasing obstructions to the navigation of the Hudson, which are extending themselves down the channel in proportion as the fields are encroaching on the

forests, give good reason for the fear of irreparable injury to the commerce of the important towns on the upper waters of that river, unless measures are taken to prevent the expansion of 'improvements' which have already been carried beyond the limits of a wise economy."

In our vast Indian Empire, the Government, until quite recently, permitted a wholesale destruction of the forests, but has now begun to open its eyes to the disastrous effects produced, and has appointed forest conservators, whose duties are to see that the trees cut down are replaced by others, as the consequences of the reckless destruction of the Indian forests by demands for railroad and other uses, have already made themselves felt by the greater frequency of seasons of drought and famine, with all their attendant miseries; and with such data as are accessible in late reports, it cannot be doubted that these calamities are chiefly due to the denudation of the forests.

It is believed, however, that with a general scheme of forest conservation, by which the annual growth might be made to balance, as near as may be, the annual consumption, these evils would be greatly mitigated, if not removed entirely.

During the last half-century, great attention has been paid, both in France and Germany, to the art of "Forestry"—an art which comprises an extensive range of knowledge of various sciences, amongst which botany, chemistry, geology, and vegetable physiology, take the first rank. The area of the French State forests is put down at 3,130,000 acres, to which may be added 5,350,000 acres belonging to "Communes," corporations, hospitals, and other public establishments, and the whole of these forests are under the management of the French administration of Forests. In the "Vosges" the destruction had gone so far that the humidity had diminished, while the soil had become more arid and inundations more frequent. In the Department of the "Gard" it did not rain in 1837 for more than nine months, and the supply from wells was most seriously diminished. At "Berjiers" it was reported that the vast forest, which once sheltered that place, having been destroyed, the loss of the olive crop was the immediate consequence. Violent storms and torrents of rain certainly fell from time to time, but these did more harm than good, as the water ran off the land without penetrating into it. Such has been the result, in France, of the destruction of a great extent of her forests; but the regulations at present in force for their conservation and "*reboisement*" are of the most stringent nature.

In Prussia proper, out of 35,000,000 of "hectares,"* 8,000,000 are classed as forests, out of which nearly 4,000,000 are private forests; in

* A "hectare" is equal to about 2½ English acres.

both cases the regulations for their management and conservation are of the most comprehensive description.

In Switzerland, the question has become of such national importance that it has been proposed to modify the constitution so as to enable the Federal Government to undertake duties which have hitherto been performed by the several cantons.

In Austria, the management of forests has recently been transferred from the Minister of Finance to a distinct department, presided over by the Minister of Agriculture.

In India, the forest question is now being regarded as one of the first importance, and is being dealt with, not by the several Presidencies, but by the General Government on behalf of the country at large.

In Canada, there has been a certain amount of legislation on this subject; but in Sweden and Norway the most rigorous measures have been devised to protect the forests, and there are regulations to prevent trees under a certain age and size from being cut even by private owners.

Now, if in countries like France, Germany, Sweden, and Norway, whose forest lands are extensive, it has been found necessary to initiate and carry out a most careful system of forest conservation, how much more so must it be necessary in the dry and sultry climate of Australia!

In the colonies of Victoria and New South Wales, the evils produced by the gradual diminution of their forests, as well as by their destruction in dry seasons by bush fires, have now become apparent, and have combined to render the climate, which is naturally dry, year by year more dry, while but little has been as yet attempted for their preservation.

The consequences must inevitably be of the most serious nature, unless immediate steps are taken to conserve large tracts of the existing forests, as well as to initiate a well-devised system of tree-planting on the bare hills which have been denuded of their forests. Should this not be done, the inevitable result will be severe droughts of long duration, occurring more frequently than at present, to the great detriment of the pastoral and agricultural interests of these colonies.

In South Australia, the subject has, however, received much attention of late, and proposals have been made by Mr. Goyder, the Surveyor-General of that colony, to initiate a systematic course of tree-planting on a large scale. Mr. Goyder proposes to reserve 200,000 acres of land, and to spend on it, in tree-planting and management, £14,000 during the first year, and £10,500 during each of the following eleven years; thus making a total expenditure of £130,000, when the whole of the 200,000 acres would be planted and fenced in. During the first five years there would not be any revenue, but during the sixth, seventh, eighth, and ninth years, the revenue

from periodical thinnings was estimated at £35,000 annually, until the end of the twenty-first year, when the colony would be in possession of 300 square miles of forest.

These estimates may possibly be a little overdrawn, but the scheme appears well worthy of consideration, and it is to be borne in mind that in no case is natural forest or "bush" so valuable, commercially speaking, as planted forest, and no one can deny the fact that tree-planting, on an extensive scale, would be a very necessary proceeding in all the Australasian colonies wherever the natural forests have been largely destroyed, to say nothing of the undoubted beneficial influence it would exert upon the climate and rainfall.

Humboldt thought that dense woods gave out what he called a "frigoric," or cooling radiation, which condensed the vaporous clouds, so that there should naturally be frequent and abundant rains in their vicinity; and, on the other hand, he thought that the warm radiations which take place from level, sandy, and treeless plains, would produce little if any rainfall, and all our experience tends to show that these views are correct.

The foregoing examples have been selected from a mass of facts illustrative of the dependence, to a large extent, of the rainfall of a country upon the preservation or renewal of its forests, whether on mountain-ranges or on table-lands, or on less elevated tracts of country. And although the meteorological action of forests is but imperfectly understood at present, yet the data hitherto collected are quite sufficient to point to the conclusion that trees, being natural conductors of electricity, as has been proved by the experiments of M. Grandeau, Professor of the "*Ecole Forestrière,*" in France, serve as intermediaries for the exchange of the electricities with which the earth and the atmosphere are respectively charged.

It has also been said that the earthquakes which are common in Spain and Portugal, would be less frequent and less violent if the elevated regions of those countries were clothed with forests, so as to secure regular and harmless conduction of the electric fluid from the aerial to the terrestrial reservoir, and *vice versâ*. However this may be, one thing is very certain, which is that hailstorms, which are believed to be produced by a certain specific electric action, become more frequent and destructive in districts which possess no forests; and on this point Signor Calvi, in his "Hints on the Importance and Cultivation of Forests," states that:—"When the chains of the Alps and the Apennines had not yet been stripped of their magnificent crown of woods, the May hail, which now desolates the fertile plains of Lombardy, was much less frequent; but, since the prostration of the forest, these tempests are laying waste even the mountain soils, whose older inhabitants scarcely knew the plague."

Enough has now been said to show the calamitous consequences of denuding a country of its woods and forests, and to show that writers of repute, who have made this subject their special study, are unanimous in connecting the occurrence of droughts and famines, the drying up of lakes and rivers, together with the outbreak of certain malarious epidemics, with the reckless destruction and waste of forests.

We are, in Australia and New Zealand, much in the same position as the inhabitants of India in this respect, and we are only beginning to feel the effects of the wholesale destruction of our forests. In New Zealand particularly, the forest question is a vital one, and the sooner it is grappled with the better it will be for the colony, the question being one which will so greatly influence its future prosperity, together with its commercial value as a colony, its climate, and its salubrity.

In a very interesting paper by Dr. Hector, showing the percentage of our forest land to the whole area of the colony, his estimate is, that between the years 1830 and 1868 the destruction of forests was as follows:—

In the Province of	Auckland	58 per cent.
"	Taranaki	10 "
"	Wellington	20 "
"	Hawke's Bay	60 "
"	Nelson	16 "
"	Canterbury	10 "
"	Marlborough	12 "
"	Westland	5 "
"	Otago	12 "

Showing that the average destruction during these thirty-eight years was about 25 per cent. During the five years from 1868 to 1873, it was estimated that of what remained in 1868, the following was destroyed:—

In the Province of	Auckland	27 per cent.
"	Taranaki	11 "
"	Wellington	25 "
"	Hawke's Bay	30 "
"	Nelson	20 "
"	Marlborough	28 "
"	Canterbury	33 "
"	Westland	21 "
"	Otago	10 "

In other words, taking the whole colony, 20 per cent. of what forest remained in 1868 had been destroyed during the five years ending in 1873!

It will be observed that in these estimates the Province of Hawke's Bay stands pre-eminent in its "bad eminence" for destructiveness of forests, which, if it continues in the same ratio, will leave it with very little, if any, standing timber in the year 1899, or in twenty years hence.

Dr. Hochstetter, in his valuable work on the geology and natural history of New Zealand, pointed out the fact that extensive districts which had formerly been covered with forests of kauri pine were, when he wrote, totally destitute of this most valuable of the forest trees, and that its extermination was progressing from year to year at such an alarming rate, that its final extinction was as certain as that of the natives themselves, only in a much shorter period of time.

Such being the facts of the case, it is surely necessary that some steps be taken to preserve a portion of our forests, and to check the continually increasing destruction which is still being carried on; and it would appear to be not only expedient but absolutely necessary that the far-seeing views which were expressed on this subject by Sir Julius Vogel, in 1874, and which were—to create a department of "Woods and Forests," and to enact forest laws, be carried out without delay.

The most stringent measures will now have to be resorted to for their conservation; a sum of money should be set apart annually for the purpose of planting and improving the State forests; every township in the colony should have its adjacent forest reserve; and every encouragement should be given to landowners towards the planting of trees on their farms and runs.

Should this not be done, after the fashion of other and older countries, and should no steps be taken to conserve our forests, the consequences will, in all probability, be of the most disastrous nature to the ensuing generation.

Art. III.—*Notes on Port Nicholson and the Natives in* 1839.

By Major Charles Heaphy, V.C.

[*Read before the Wellington Philosophical Society*, 11*th October*, 1879.]

Having been in Port Nicholson before the arrival of the settlers, I have put together the following notes on the physical aspect of the place, and the condition of the native inhabitants at that time.

In September, 1839, when I arrived here in the 'Tory,' with the expedition to select a fitting site for the New Zealand Company's first settlement, no ship had been in the harbour for a considerable time, probably three or four years. The place lay out of the track of whaling ships, and there was but little flax-trading to be done at it. Large, and for a time prosperous, whaling-stations existed at Port Underwood, Tory Channel, and Kapiti. The tide running past the heads on into those harbours, whale-ships lay at anchor there, with their boats in readiness, and nume-

rous shore-parties watched throughout the winter months for whales that, coming inshore during the breeding season, were entangled or swept by the tide into the bays, where they could be attacked with advantage, and when killed, towed, with the aid of the flood or ebb tide, alongside the ship or under sheers of the shore establishment. At Port Nicholson heads, the tide was not so strong as to draw in the "fish," as they were termed, and as a consequence the place was unfrequented, and remained with its people in a more primitive condition than any of the surrounding harbours.

The forest was more undisturbed. Along the eastern shore, from the mouth of the Hutt River to outside of Ward Island, the forest was uninterrupted, and the trees overhung the water, giving shelter to great numbers of wild fowl.

About Kaiwhara, Ngahauranga, and the Korokoro, the earthquakes had not then raised the coast, and caused the beach, now occupied by the railway, to appear, and there, also, the trees overhung the water, leaving only at the ebb of the tide a space sufficient for a pathway.

The indigenous birds had been entirely unmolested, save when the Maori snared them in his furtive and noiseless manner. I remember, especially, the enormous number of waterfowl frequenting the shallows at the mouth of the Hutt River. Cormorants, ducks, teal, oyster-catchers, plovers, sand-pipers, curlew, and red-legged waders, were there in pairs, detachments, and masses, and so tame that it was slaughter, rather than sport, to shoot them.

At the beach at the head of Evans Bay, there were, beside ordinary waterfowl, flocks of Paradise ducks (*Casarca variegata*). In the low fern and sandy shores of Island and Lyall Bays the indigenous quail, now disappeared, would rise almost at one's foot with its shrill, startling whistle, while along the rocks the slate-coloured cranes (*Ardea sacra*), two and two, were to be seen making erratic darts after shrimps, or patiently waiting for a passing fish.

The forest was then teeming with birds. Of twelve or fourteen species of small birds that were then to be seen in every wood, only the tui, the fly-catcher, and the wren, with the sand-lark, in the open, are now common, while the robin, the bell-bird, the titmouse, the thrush, the popokatea, the tiraweke, and the riroriro, are rarely seen or have entirely passed away.

Of the larger birds, the kokako, or crow, the rail, pukeko, pigeon, kaka, and huia, were numerous in their respective localities or feeding-grounds. Of a night might be heard the booming, or "drum," of the bittern (*Botaurus pœciloptilus*). The weka (*Ocydromus earli*), now common about the Hutt Valley, was then so scarce, that for more than three months our naturalist

was unable to obtain one, alive or dead, or even to see a skin. I think this singular alteration in the bird's numbers has been noticed in Southland. This bird, although not at all shy, is very pugnacious, and can defend its young from either the rat or the cat, hence, probably, its singular increase.

The huia (*Heteralocha acutirostris*) was then to be found in the ranges between Wainuiomata and Palliser Bay. Dr. Dieffenbach, the naturalist, was anxious to obtain some, and I accompanied him, making sketches, to the high range that overlooks Palliser Bay. The natives are very fond of the feathers of this handsome, dark, velvetty bird, with its yellow wattles and white-tipped tail, and two boys readily went with us as guides. There was no occasion to take much food into the bush in those days—the gun supplied game enough—and though the month was September, one blanket was considered sufficient bedding for the open-air bivouac.

We struck in from near Lowry Bay, and reached the source of the Orongo stream before night. There was no path whatever. We shot some kakas and snared a kokako, but saw no huias. We made a good fire as night approached. The natives were awfully afraid of the Wairarapa people, against whom they had lately fought, and while we slept with our feet near the fire, they sat crouched, with our guns in their hands, listening to detect any possibly approaching footsteps, for they were on the debateable land of the two tribes.

The only sound worth noticing was the beautiful melody, towards morning, of the bell-birds. Thousands of these were singing together, and, probably by some auricular delusion, the sound seemed to arrange itself into scales, like peals of bells running down octaves. As the sun rose this music ceased altogether. From the top of the range we had a fine view of Palliser Bay and the Wairarapa Lakes. On our way homeward the natives suddenly stopped; they heard in the distance the peculiar cry of the huia. Imitating this, and adding a peculiar croak of their own, which they said was very attractive, our guides soon brought two birds—a male and female—within shooting distance. We abstained from firing for a moment, admiring the elegant movements of these birds as they leaped from tree to tree, peering inquisitively at us, and gradually coming nearer. We now fired with light charges, and brought each a bird down. Our natives were annoyed at our "griffinism." They had intended, by a further allurement of a peculiar gutteral croak, to have brought the birds so near as to capture them with a common slip-knot at the end of a stick—a process which we saw subsequently performed with entire success. As we descended the spur near the mouth of the Hutt River, a whale and its calf were tumbling about between Lowry Bay and Somes' Island. They were "finbacks," and of no commercial value.

On another occasion I accompanied a party of natives into the hills, near Belmont, to spear pigeons. The spears are about twelve feet long, and very slender—not more than half an inch in diameter at thickest part. They have to be held near the point, and, on a journey, trailed behind, until wanted for immediate use. The pigeons are probably feeding in low trees, or are about water-holes, and are scarcely frightened at the approach of the hunter, who quietly steals under them, sometimes even ascending the lower branches of the tree the bird occupies. The spear is then quietly directed amongst the foliage towards the breast of the bird, which takes little notice of the operation. When the point is within half a yard, a sudden thrust is made, and the bird is transfixed. The point of the weapon is of bone, and barbed. This bone is hung securely by a lanyard at its base to the spear-head, but when ready for use is lashed with thin thread alongside the wood. The wounded bird flutters with such force as would break the spear were the whole rigid, but as arranged, the thread breaks, and the bird on the barbed bone falls the length of the lanyard, where its strugglings do not affect the spear, and it is easily taken by the fowler's left hand. This mode of capturing birds, very soon after our arrival, went out of vogue. The spears were exceedingly difficult to make, and the few that were finished were eagerly bought by the whites as curiosities.

Our ship lay to the northward of Somes' Island, and frequent trips were made of an early morning to haul the fishing-net in Lowry Bay. Large trees there overhung the beach, making it a delightful camping-place. We were always successful with the net, taking large quantities of kahawai, moki, and flounders.

From this bay the course by boat into the Hutt River, and up the branches into which it divides, was most interesting and picturesque. A pa stood at the mouth of the river on the eastern side, with large war-canoes drawn up on the beach, while at the hill-foot were tall stages, from which hung great quantities of fish in the process of sun-drying. Here the natives came out and hailed the boat's crew to land, for ashore it was high festival. Their canoes had come in, the night before, from Island Bay, loaded with "koura," or cray-fish, which were at the moment cooking in the "hangi," or Maori stone-oven, with pumpkins, cabbage, and potatoes.

The natives here were exceedingly apprehensive of an attack on the part of the Wairarapa tribe, who, if so disposed, could steal down the wooded hills and appear in the cultivations amongst the scattered working parties. Only two years previously bloody fights had taken place in the Wairarapa Valley, and though peace was ostensibly made with the tribe, reprisals from persons or families that had lost relatives might be dreaded. Thus

the men always had loaded fire-arms by them, and the "waka taua," or war-canoe, was always ready for an expedition.

From the pa we pulled up the Waiwhetu River, which there had lofty pine trees on its banks. The various bends were very beautiful and secluded, and seemed to be the home of the grey duck and teal, and numerous other wild fowl. Here and there, on the bank, was a patch of cultivation, and the luxuriant growth of potatoes, taros, and kumeras, indicated the richness of the soil. As seen from the ship, or the hills, a lofty pine wood appeared to occupy the whole breadth and length of the Hutt Valley, broken only by the stream and its stony margin. This wood commenced about a mile from the sea, the intervening space being a sandy flat and a flax marsh. About the Lower Hutt and the Taita, it required a good axe-man to clear in a day a space large enough to pitch a tent upon. The cultivations of the natives were nearly all on the hill-sides, and chiefly about what is now the Pitone railroad station.

The path to the West Coast led up the hill from the west end of Pitone beach, and was very steep and difficult. There was one fine view-spot on the summit, and the track descended to the Porirua valley at what is now Mr. Earp's farm. There was then no path from Ngahauranga or Kaiwhara, but a war-track existed from Belmont to Pahautanui.

The site of the City of Wellington was, in 1839, covered at the Te Aro end with high fern and *tupakihi*, save about the upper part of Willis Street and Polhill's Gully, where there were high pine trees, partly felled for native cultivations. Wellington Terrace was timbered chiefly with high *manuka*, some of the trees forty feet high. Thorndon Flat, about Mulgrave and Pipitea Streets, was fern-covered, but with high trees towards the Tinakori Road. The native cultivations were along what is now Hawkestone Street, Tinakori Road, and the base of Tinakori hill, the sides and summit of which were densely timbered, the *rata*, with its crimson flowers, being conspicuous.

The native villages were—first, Pakuao, with two or three families, at Dr. Featherston's; Tiakiwai, where Mr. Izard lives, with three or four families; Pipitea, from Mr. Charles Johnston's to Moore Street, with about fifty natives; Kumutoto, Lindsay's to James', twenty natives; and Te Aro pa with sixty natives.

From Mr. James' to the Court House the beach was so narrow as barely to afford room for passage at high-water, between the sea and the cottages that were built close under the hill, or on sites dug out of its foot. Where the Bank of New Zealand stands there was a short reef of rocks, at the foot of "Windy Point." The site of the present cricket ground was a deep morass, arranged by the surveyors for a dock reserve; after the earthquake of 1848 raised the land, generally, about the harbour, it became drainable.

The land-slips on the Orongo range, to the eastward of Port Nicholson, were not existing in 1839; they are said, and I believe correctly, to have been caused by the great earthquake of 1848. This was thirty-one years ago, and vegetable growth has not yet concealed the clay and sandstone that was then laid bare. As there were no such slips anywhere about Port Nicholson in 1839, it is, I think, a fair deduction that no shake of equal severity had occurred for at least thirty-one years prior to that date. In exploring the country, and whilst encamped on various parts of the Hutt Valley, I had opportunities of remarking the freshets of that river, and am of opinion that they did not rise so fast, or prove nearly so destructive to the banks, as during the last ten or twelve years.

Natives.

The Port Nicholson natives, when the 'Tory' arrived here, were a fine specimen of the Maori race. All the men were tried warriors, and had fought successively the Waikato, the Wanganui, and the Wairarapa people. But they occupied rather an inconvenient corner of territory. As long as they could maintain peace with the Ngatitoa at Porirua and Kapiti, and the Ngatiraukawa of Otaki, they were tolerably safe; but in the event of serious hostilities in the direction of the West Coast, and such hostilities were threatening, the Wairarapa people, whom they had defeated but not subdued, would operate in their rear, making the position very critical.

It was this feeling of insecurity which caused them so readily to sell land to Colonel Wakefield, and to hail the arrival of Europeans. Having determined on the policy to pursue in this matter, Epuni, the Chief, with his immediate people, behaved with great consistency, and never receded from his bargain, or wavered in his friendliness to the settlers. There was a singular mixture of amiability and fierceness about these Port Nicholson natives. The circumstances of their position required them always to have arms ready beside them and the war-canoes at hand on the beach, but to the white people they manifested entire confidence, and exhibited the greatest kindness. When the schooner 'Jewess' was stranded on the Pitone beach, they helped to dig a channel for her to the sea, and eventually, by force of numbers, animated by their war yell and chorus, dragged her until fairly afloat. At the subsequent upsetting of a passage-boat in the surf at Pitone they risked their own lives—men, women, and children—to rescue the exhausted Europeans from the fatal undertow.

Ere the purchase of the land was well completed their relatives were treacherously attacked by the Ngatiraukawa in force at Waikanae, and it required hard fighting, with all the advantages of position, to beat them off. Ere the excitement of this attack had passed away the chief of Waiwhetu, Puakawa, was shot in his potato field by a marauding band from Wairarapa.

Arriving at Waikanae, as we did, just after the action terminated, it may be interesting to notice what occurred. The Waikanae pa stood on the sand-hills, behind the beach, and may have contained about 350 natives, of whom about 200 were fighting men. The attack had been made just before daylight on a small outpost of the pa, where a boy noticing a strange native peering into the *whare* seized a gun and shot the intruder dead, thereby giving the alarm and arousing the inmates of the larger pa. The attacking party now surged against the stockade of the main village, but were fiercely resisted. Spears were thrust through the fences, and men shot down in the act of surmounting them, but no entrance gained. Then the fight would lull for a time, to be resumed outside in rough "scrimmaging," as the whalers called it, amongst the sand-hills.

Te Rauparaha, the great Ngatitoa chief, watched the fight. He professed friendship for the Waikanae natives, but had come over from Kapiti Island to assist the Ngatiraukawa with his advice, rather than materially. He was seen by the people within the pa, and a quick rush out was made to capture him. The Ngatiraukawa interposed and sacrificed themselves to save him. The fighting was here hand to hand, but Te Rauparaha escaped, only however by swimming off to his canoe, which was moored outside the surf. We met him ere he arrived at his island, which was distant about three miles from Waikanae. He looked crest-fallen, but was composed and self-possessed, and more than usually friendly in manner.

On Te Rauparaha's departure the Ngatiraukawa became dispirited, and carrying off their wounded, retreated rapidly along the beach towards their fortified pa at Otaki. The doctors of our expedition immediately proceeded to the assistance of the wounded. We entered the pa about three hours after the fight was over. The chief, killed by a musket-ball, lay in state on a platform in the large enclosure; his hair was decorated with *huia* feathers, a fine *kaitaka* mat was spread over him, a greenstone *meri* was in his hand, with the leather thong around his wrist; his spear and musket were by his side. The bodies of slain persons of inferior rank were lying in the verandas of their respective houses, each covered with the best mat, and with the personal weapons conspicuously placed beside.

Around the bier of the chief the people of the pa were standing in a circle, performing the *tangi;* the women, and several of the men, had divested themselves of clothing down to the waist-belt, and were bleeding profusely from a series of cuts inflicted in the ecstasy of their grief. It was not for the chief only that the *tangi* was proceeding, each person there had some near relative lying dead within a few feet of where they stood, and the cold and placid face in their midst was only the objective embodiment of their mourning. Several of those in the circle were themselves desper-

ately wounded, and supported themselves on the shoulder or hand of their neighbour, decorously to pay the melancholy rite.

But a party of men were still out amongst the sand-hills burying the dead of the enemy, or bringing in the corpse of a friend. Before we entered the pa we noticed, standing on a provision stage high up above the stockade, a woman, who appeared by her violent gesticulations to be much excited. Closely following us as we passed into the stockade was a litter-party carrying a dead body, the last of the missing. Suddenly there was a heavy fall, or thud, close by us; it was the woman from the high stage, recognizing at last the corpse of her son she had frantically thrown herself down, nearly twenty feet, and lay there, apparently dead, while the litter-party passed on. Such matters were apparently of trifling moment while a *tangi* was proceeding.

There were a number of seriously-wounded men to be attended to, and gun-shot to be extracted. One native had the *tendon-achilles* cut through, and the foot was drawn upward and powerless. To some bones of the arm and leg, fractured by shot, they had already applied splints, fairly made from the thick part of the leaf of the *Phormium tenax*. To cut and lacerated surfaces they had applied dressings of herbs. How far these were effective, medicinally, it is impossible to say, but after a few days nearly all the wounded were progressing favourably and without fever. One man had his knee smashed by a bullet, and he was advised to submit to amputation. He agreed to have the operation performed, and was told about being able to walk with a wooden leg. The children considered there was fun to be found in wooden legs, and proceeded to manufacture them according to their lights—stumping about before the wounded man. At this ridicule he changed his views, and said that he would rather keep his leg and have it buried with him than live to be laughed at.

Most of the wounds healed by what is termed "first intention." The severed *tendon-achilles* united, but with increased length and consequent loss of power in the foot. The Ngatiraukawa had 45 killed, and the defenders of the pa 14 killed and about 30 wounded. The man with the injured knee recovered for a time, but with a stiffened joint. Four years afterwards he had it removed by Dr. McShane, of Nelson. He smoked his pipe during the whole of the operation.

Art. IV.—*On the Principle of New Zealand Weather Forecast.*

By Commander R. A. Edwin, R.N.

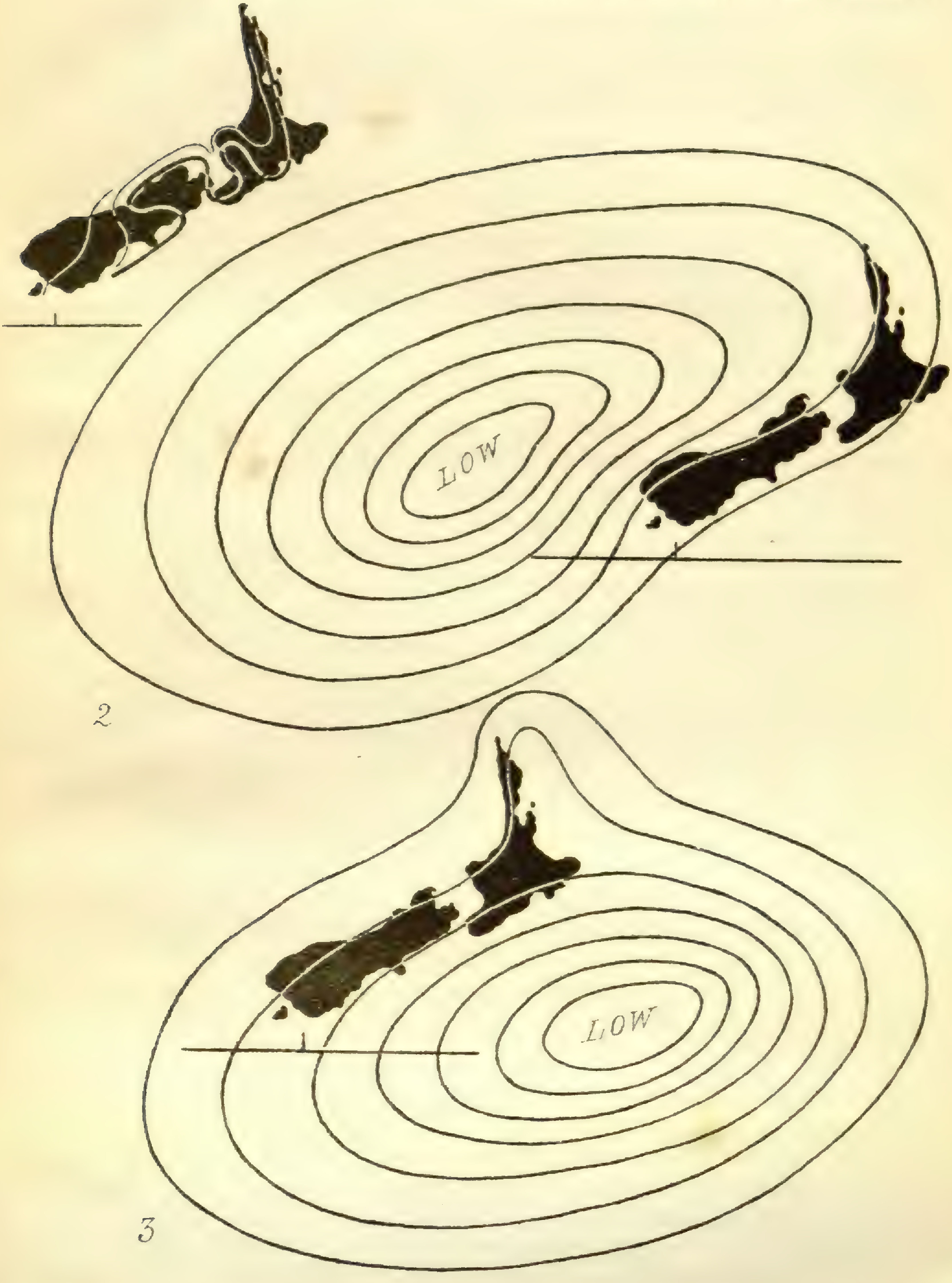
Plates I–III.

[*Read before the Wellington Philosophical Society, 11th October,* 1879.]

The subject treated of in this paper is one which has for some years past received great attention in other countries, and their publications upon Weather Forecast give us ample information as to the method by which their predictions are arrived at, and the measure of success which has attended their efforts. It is now proposed to give some description of the manner in which the Weather Forecast of this colony is carried out. The subject is one which may be considered of general interest, and the method of procedure differs in some respects from that practised in other countries; but as it has already stood the test of some remarkably changeable seasons, with a large percentage of success, it seems now desirable to invite further investigation in the matter.

In the first efforts to arrive at some conclusions as to probable changes in the weather, the principal difficulty which came under consideration was the deflections which the mountainous nature of the country seemed to have power to create, not only in the direction of the wind, but also in the distribution of pressure. For instance, an isobar will generally run very fairly from Russell to Grahamstown, Tauranga, Gisborne, and Napier; but instead of continuing toward Castlepoint and Lyttelton, it will be found to curve inland and westward toward New Plymouth, then to turn southward between the latter place and Wanganui, and return eastwards towards Castlepoint which it leaves on its right. Now, it will be found upon investigation that pressure is nearly always higher at Westport and Hokitika than at Kaikoura, which necessitates this isobar being again drawn westward, *i.e.*, back through Cook Strait, and passing Cape Farewell turn toward south to Westport and Hokitika, from which point it returns eastward, passing out between Blenheim and Kaikoura. A second isobar should have commenced at Auckland and run toward Taupo, Wanganui and Blenheim; and a third might be reasonably expected to pass over Westport, Hokitika, Queenstown, and Balclutha; but it is evident that, according to meteorological law, they must follow the first line of equal pressure upon that side which will show that they define the position of a lower pressure, and this necessitates their following it through all its sinuosities, but westward of it.

Such distributions of pressure were found to be by far the most prevalent state of affairs, and in many instances the curves were much more distorted than shown on the diagram (*Pl.* I., *fig.* 1), but it seemed probable that other disturbing influences must also be in existence, and tending to



To illustrate Paper by Capt Edwin, on N.Z. Weather forecasts.

exaggerate whatever was due to irregularity of the land surface; and it was only by closely watching the changes accompanying the passage of every low area, and patiently endeavouring to assimilate these conditions, that it became evident that the complications already alluded to were the result of there frequently being more than one low area in the vicinity of the country at the same time.

One of the principal aids in arriving at this conclusion is derived from the substitution of contour lines for the isobar as generally drawn; these isobaric contours are drawn in the direction which the wind blows to—flow in fact with the wind—and the idea of adopting this plan originated in an endeavour to comprehend local peculiarities, for it was evident after investigating such remarkable distributions of pressure as those already referred to, that, if warnings were sent of an approaching gale, they must make known the limits within which it would be locally experienced, for if the warning were based upon theoretical principles it would frequently be incorrect, and the calculation of gradients under these circumstances seemed rather difficult.

In drawing these isobaric contours, the mobile nature of air has to be taken into consideration. We all know how susceptible it is of expansion or contraction, to changes of temperature and pressure; and this being the case, it is but a step further to allow that a cyclonic wind, whose shape may be assumed as circular while beyond the influence of land, may become much changed in shape when it approaches a mountainous country, and by reference to Piddington and other writers upon circular storms it will be found that this point has already been under notice; but a little further consideration will show that this is not the only difficulty that has to be dealt with, as it will soon become evident that the subject contains some complex features; for while the front or advancing curves of a cyclone, encountering high land, become retarded and deflected, the centre continues to press forward with undiminished speed, and consequently the isobars become packed in the vicinity of the retarding influence; but from these causes the curves will have a tendency to open out at the rear of the cyclone (*Pl.* I., *fig.* 2), and as the land has a retarding effect upon the cyclone's advance, so will it also act upon it after the centre has passed, causing the rear curves to be extended; but the advancing curves will be compressed under either condition (*Pl.* I., *fig.* 3).

In drawing these isobaric contours, it must be constantly remembered that they must never cross each other, and that the object must be to endeavour to depict a series of concentric rings more or less bent out of their true shape; each tenth of an inch of barometric difference must be thus shown flowing in the direction toward which the wind moves, and each curve in itself

reciprocating the movements of the curves upon either side of it, and every advantage must be taken of river-channels, mountain-passes, and other such routes by which the contours can be shown to make their way across the country; the state of the sea, especially at exposed places, must also be carefully shown by these contours; and by close attention to these principles, the occurrence of gales at points far distant from each other, and the existence of but moderate winds at places close to where such gales exist, can be accounted for, and reason can be shown why the sea-disturbance is subject to similar irregularities, all apparently the effect of purely local causes working independently of each other, but which are in reality part of one system, whose effect is intensified at these points.

The isobaric contour also enables another difficulty to be accounted for; viz., the fact that the barometer moves more rapidly at some places than it does at others; and why, after it has fallen from a high point at all stations, there are frequent instances of its not recovering its original position over a considerable extent of country for a long time; for instance, let it be assumed that pressure ranges between 30·50 in the northern part of this colony, and 30·20 in the south, and that a fall takes place amounting to about seven-tenths of an inch in the latter, and two-tenths in the former districts; now, when a recovery sets in it will be found that the barometer seldom rises to its original position at all places by a difference not unusually amounting to half an inch at the southern stations, and although rapid oscillations may take place in that part of the colony, yet pressure southward of Napier does not return to its original position for a period varying from a few days to several weeks.

This general position of the lower pressure toward the south is in accordance with our meteorological knowledge of this hemisphere, but it does not seem to offer an explanation of why high readings of the barometer in the south are not so unusual as may generally be supposed, and it should render forecast easy, as it gives a gradient showing westerly winds; but experience in storm-warning shows that easterly winds are frequent, and easterly gales must by no means be left out of the estimate of probable weather, especially at places lying south of the 40th degree of latitude, as it almost invariably happens that whenever the wind backs at places southward of Napier it changes into north-east, although it does not always blow a gale from that quarter.

In the attempt to account for some of these points the isobaric contours were of great value, and their use led to the idea of the possibility of the existence of multiple areas lying southward of contours, or lines of higher pressure, which retreat or move northwards as the low areas approach; advancing southwards when they have passed, or if they are passing at a considerable distance

from the country. These are the special principles of New Zealand Weather Forecast; and the diagrams (*Pl.* II.) accompanying this paper of the pressure within the New Zealand area on 7th, 8th, and 9th July, 1879, are examples drawn in accordance with its rules, but they must not be considered specimens of actual forecast—a subject which will be treated of in another paper.

In these diagrams the wind deflections are eliminated, and they are, in fact, diagrams of the results already arrived at.

In support of the system now in use it may be urged that if according to accepted principles each cyclone, or area of low pressure, is a complete circle, then it follows that from whatever point pressure commenced to diminish it must return to that point again as the low area passes away, unless it be assumed that, instead of pursuing a direct route, the cyclone has moved in a more or less erratic course, but by this principle of multiple areas we can readily perceive that it is possible that gale may succeed gale in rapid succession, and for a considerable period, each depression following its predecessor, and the whole system moving in a more or less curved but well-defined route; and it obviates what has always appeared to me to be an impossibility, viz.: the retrograde movement of any low area.

Secondly: the facility with which the approach of a "backing" wind can be foretold; this "backing" being in reality the advancing curves of a new depression, whose approach will cause pressure to diminish before it has reached the point from which it at first commenced to fall. The proximity of such an area is shown by the extent of the area over which the barometer is shown to be rising, and, together with the further area over which the isobaric contours show that pressure is likely to increase the sea-movement, has also to be taken into consideration.

Thirdly: the advantages afforded by it for reliable forecast of sea-movement, a point of information which is of considerable value to bar-harbours and roadsteads.

This principle of contour lines and multiple areas enables an explanation to be offered as to how such complex movements, as a decrease at the extremes and an increase in the central portions of the country, can take place; and, also, why several successive rapid movements may take place in the south without being nearly so remarkably produced in the north; and it also affords a means of determining the positions of the depressions, although they may lie at a considerable distance to seaward.

It also shows the existence of what may be termed double-centred areas of low pressure; in these the barometer falls rapidly, the wind veering by north and west and blowing a heavy gale, a recovery then sets in, the wind changes southward of west, and the barometer rises rapidly for about half an inch, and immediately that it reaches its highest point it commences to

fall again within a limited area, but continues to rise slowly at places beyond those limits, while within them the wind suddenly "backs" to the north-east, and a second hard northerly gale becomes rapidly developed within this area; this second fall usually reaches the same point as its predecessor, the barometer then makes a second rapid increase which extends to the whole colony, and a heavy gale from the southward is generally experienced, this being the second southerly gale within the limited area already mentioned; the lowest pressure in these gales generally ranges between 28·90 and 28·50, and the total fall at the southern extreme of the colony amounts to about 1·25 inches.

These areas usually travel about east by north, and the general, or I believe it may be termed the normal routes of the gales which approach New Zealand, are between W.S.W. and S.S.W., moving to the opposite quarter; but after a considerable period, generally not less than six months, a depression comes in from the north-west, after whose passage the normal route is resumed, and this change takes place, on some occasions, with such promptitude that it is difficult to issue warnings in advance of it. Comparatively few of these north-west areas have come under investigation since the principles of Forecast now in use have been fully in operation, but there have been several of them, and there is no doubt that they, at times, are of the class here described as double-centred. The depressions which approach from the west of south are systems of multiple areas, some of which are of intricate construction, and during their passage the wind changes from north-east to north and west, veering as we term it in New Zealand, but backing according to meteorological law; and, as each successive area approaches us, the wind moves from west of south to north of west, which we term backing, but which is a veering movement according to meteorological law. From these remarks it will be seen that the wind-change in this colony is the same as in Great Britain, but during the passage of areas from north-west the wind obeys the laws for the Southern Hemisphere.

An interesting subject for investigation is offered by the atmospheric circulation of the temperate zones; for in England and America the same routes seem to hold good as in New Zealand, the depressions travelling from south of west to the north of east, and being at times interrupted by the passage of an area from north-west, and it thus appears that northern countries are mainly supplied from a tropical direction, the balance being restored from a polar quarter, whereas our supply is generally derived from the polar side, and recouped, as it were, from the tropic.

A marked feature of this Forecast are binding isobaric contours, or binding-lines, which enclose the secondary and minor areas, and which are

detected by pressure being lowered by successive steps, none of which are immediately recovered. These binding-lines are an indispensable feature of the work, and to explain them more readily it is necessary to refer to the accompanying diagrams (*Pl.* III.), the first of which is intended to illustrate the passage of a system whose low areas travel on a route inclined about 67° from the true North or E.N.E. It extends over a period of eleven days, an interval which has been, for convenience-sake, extended to fully one-third more time than such a system would usually occupy. Each division upon the line of route represents 24 hours, further subdivided into 12-hour spaces; and by moving the diagram on the line of route, making each division coincide with that upon the fixed line, and marking the barometer readings at Hokianga, Wellington, and Bluff upon the usual form of register, an illustration will be obtained of how movements, which do not appear to have much in common, may be shown to be the result of one system of depressions, and that they are in reality reciprocal.*

This diagram shows that on the *first* day the barometers were 30·55 at Hokianga, wind north-west; 30·47 at Wellington, wind north-north-west; and 30·30 at Bluff, wind north. As we advance the diagram to the right, we find, after an inverval of *twelve hours*, that it has fallen nearly a tenth at Hokianga, five-hundredths at Wellington, and one-tenth at the Bluff, but without any material change in the wind-direction, though it will have increased in force, and would under these circumstances amount to a strong wind at places in the South Island. By the *second* day we find pressure still diminishing, and that during the last twelve hours the barometer has fallen to 30·40 at Hokianga, 30·30 at Wellington, and to 30·00 at Bluff. The wind has at each of these places changed more towards west, backing according to meteorological law, but veering according to our views, and a heavy northerly gale is now blowing at places lying southward of the contour of 30·30, there being also a heavy north-west sea at Greymouth and Hokitika. A further interval of *twelve hours* shows that the barometer is still falling; and on the *third* day it reads 30·25 at Hokianga, wind west; 30·10 at Wellington, wind north-west; and 29·60 at Bluff wind about north-west. The total fall at this station now amounts to seven-tenths of an inch in three days, which would in reality have occurred within one, but it has been extended for the sake of keeping the curves further apart. By continuing the movement of the diagram to the right, we find that within the next *twelve hours* the barometer at Bluff makes a further downward movement to 29·55, giving a total decrease of seven-and-a-half

[*NOTE.—For the moving diagram, a chart has been, for convenience sake, substituted, on which the position of New Zealand is depicted in relation to the isobaric contours at successive periods of two days' interval (*Pl.* III.).]—ED.

tenths, and that within the same twelve hours it rises to 29·64, the wind veering south of west as pressure increases. A southerly gale is now blowing over the South Island, and a heavy sea accompanies it at Greymouth and Hokitika; but the barometer is still falling at Hokianga and Wellington, and we further find that it rises at Hokianga, where its lowest point is 30·25 before pressure has at all increased at Wellington, where it falls to 29·93. On the *fourth* day the barometer has risen to 29·90 at Bluff, the sea making moderately on the eastern coast; at Wellington the wind has changed southward, and pressure has decreased to 29·88; and at Hokianga the barometer has risen a little. The wind is now from the southward of west throughout the colony, and the low area which has just passed is now shown to the eastward.

Now, if this cyclonic wind is a true circle, pressure should continue to increase in all parts of the colony until it has returned at all stations to the point from which it commenced to diminish, and the wind should change to eastward of south; but these conditions are frequently delayed for a considerable time, and it generally happens that the barometer commences to fall again in the south long before it has attained the height necessary to ensure complete cyclonic formation, the deficiency being curiously graduated, the approach to the complete form being most nearly attained in the north and becoming markedly less so in the south.

To anticipate this falling movement, which is always accompanied by a backing wind, is one of the difficulties of weather forecast; and, as its occurrence is a sure sign of more bad weather, it is evident that a warning received after it has taken place is deprived of much of its value in practice. The approach of this backing movement is shown by the tendency of the curves to open out, caused by there being but little difference of pressure at adjacent stations. It is more readily detected in the southern than in the northern part of the colony, there being a wider land-area in the former case, and it is also accompanied by a decrease of sea on the western coast of the South Island; unless the new area be of large dimensions, in which case the sea will change northward, even while the barometer is rising; or, if the depressions are passing more to the southward of us than usual, and are at the same time moving on a north-easterly line, then the sea will continue from the south-west, as if the barometer were about to continue rising.

Another point of value is humidity, which will usually be found to have decreased as the barometer rises, but not to the extent that the increased pressure would imply, while, in some instances, it will be found that an increase accompanies an increase of pressure; neither of these movements seems unreasonable, if it can be admitted that the northern winds of one depression can exist in close proximity to the southern winds of the one im-

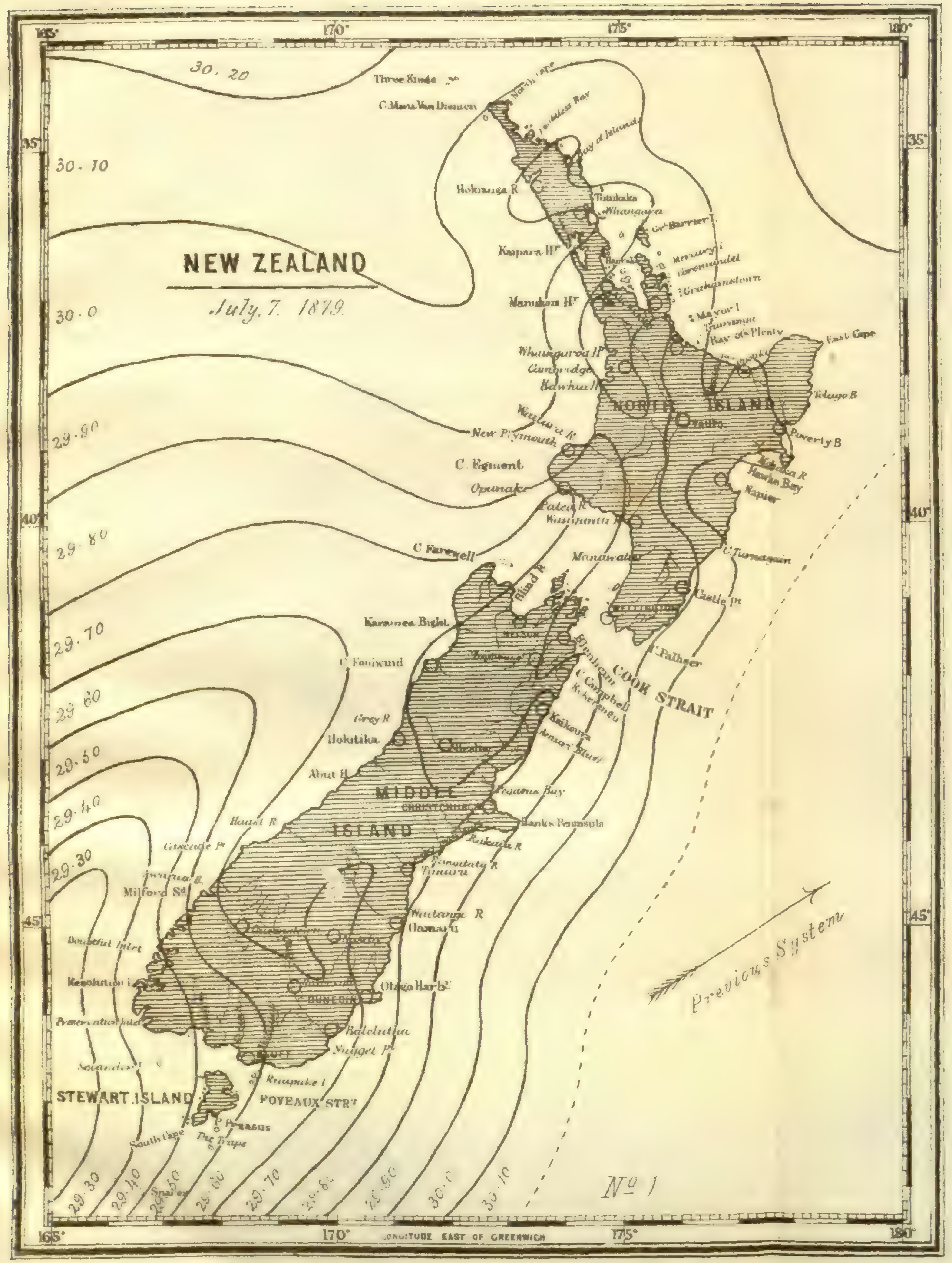
mediately preceding it; in the space intermediate between the areas the weather is nearly always fine with light winds, whose direction mainly depends upon whether the place is nearest to the approaching or departing depression.

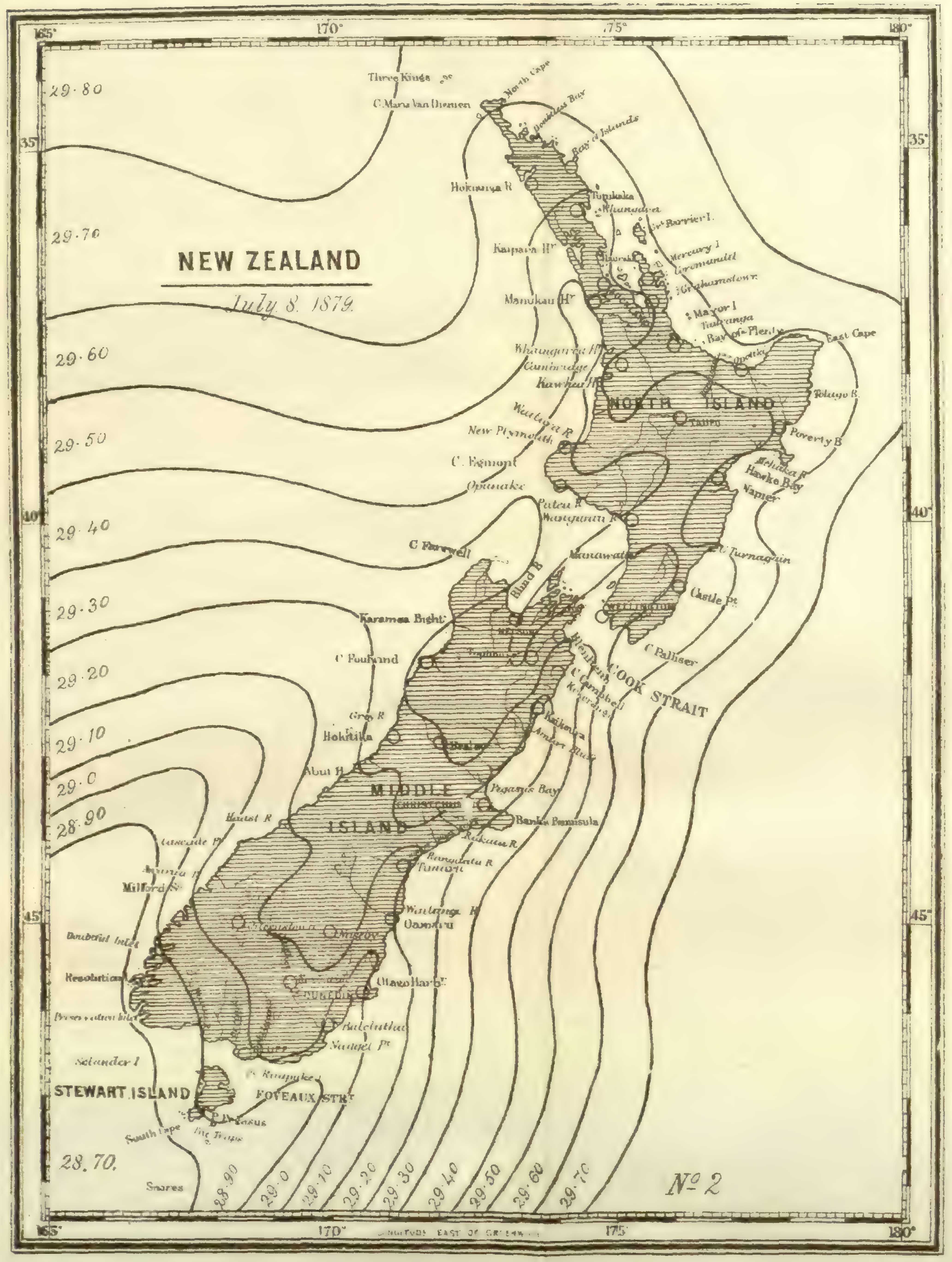
In this example the space between the two is shown to be 29·90, and thus the line of 30·0 becomes an isobarometrical binding-contour or binding-line of one or more such areas as have just passed, and if pressure again diminishes, the re-appearance of all the contours above 30·0 will be delayed, and therefore they are also binding-lines; but as experience shows that pressures above 30·10 are of much less frequent occurrence at the southern stations than at others, it will be more convenient to consider 30·10 as the first binding-line, 30·0 the second, and so on, should the systems be sufficiently complex to necessitate the number of these lines being increased.

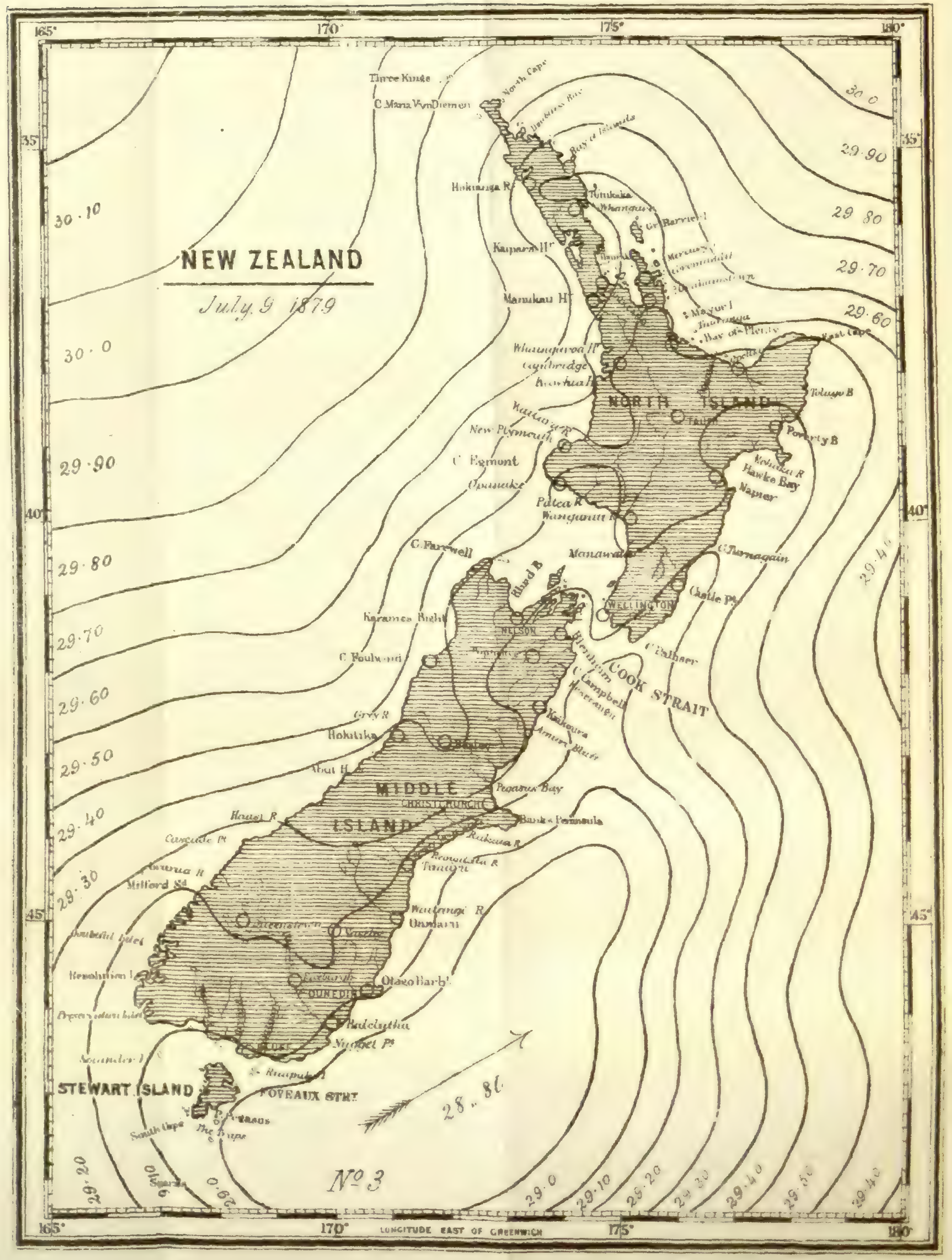
Referring again to the diagram, it will be found that while the wind continues from the southward upon the eastern and western coast, it has already backed at the Bluff, and as the diagram moves along it shows pressure diminishing rapidly in the south, and within *twelve hours* it has fallen to 29·75 at Bluff, wind north, and a second northerly gale has now commenced, accompanied by a heavy sea upon the western coast; but at Wellington the barometer has risen to 29·95, wind still from the southward, while at Hokianga it has risen to 30·28, wind W.S.W. The *fifth* day shows a further fall to 29·55 at Bluff, and a corresponding movement has evidently taken place over a wide area, resulting in a heavy northerly gale; the barometer has now risen to 30·0 at Wellington, the highest point reached being about 30·02, the wind soon afterwards backing to N.W., while but little change has taken place at Hokianga; within the next *twelve hours* the barometer falls to 29·45 at Bluff, and it also rises to 29·50, wind as before, veering southward as pressure is increased, and causing a heavy sea on the western coast; at Wellington the barometer falls to 29·86, and although this is only a fall of 16/100 it is accompanied by a heavy northerly gale at this station; at Hokianga the barometer falls to 30·22, wind W.N.W.

On the *sixth* day a further increase has taken place in the south, the reading at Bluff being 29·72; a hard southerly gale is now experienced throughout the South Island, but pressure at Wellington has diminished to 29·78, and at Hokianga to 30·18, the wind having now changed south of west at both places; *twelve hours* later the barometer has risen to 29·90 at Bluff, and the gale has now decreased at stations south of Lyttelton, but is blowing hard between that place and Napier, barometer reading 29·82 at Wellington, rising; and 30·15 at Hokianga, where it has fallen slightly, the wind being a gale from the southward of west at both places, and the sea is now heavy between Kaikoura and Castlepoint.

Now, according to the difference in pressure, which has been frequently shown by this diagram as existing between Hokianga and Wellington, it is evident that gales should have been more generally mentioned as occurring at the former station; but in practice this is not found to be the case nearly so often as these differences would admit; and this is mainly caused by there being a spreading out of the contours at the upper part of the North Island, which will be more readily understood by a reference to Diagram No. 1. The second low area is now shown to the eastward of the colony; and by the *seventh* day pressure is shown to be still increasing. The second binding-line has passed the Bluff, and this is evidently the first occasion upon which the barometer has stood at 30 inches at that station since the commencement of this series; pressure at Wellington has risen to 29·90, and to 30·18 at Hokianga. This seventh day shows the second depression at a long distance from the land, but it is evident by the contours that it continues to influence the weather, as the winds are still all from the southward; but there is now again a widening of the contours in the South, showing the approach of a backing wind; the barometer at Bluff now reads 30·02. A further interval of *twelve hours* shows that pressure has continued to increase in the North, the readings being 30·0 at Wellington, and 30·20 at Hokianga, but at Bluff it has fallen to 30·0, and the wind has backed into north. It now becomes evident that the first binding-line of 30·10 encloses not only the two areas which have already passed, but that perhaps several more may be approaching. The *eighth* day shows a fall to 29·85 at Bluff, but it has continued rising at Wellington, where the barometer reads 30·06, the second binding-line having passed, and pressure has also increased at Hokianga to 30·25. The diagram now shows that during the next *twelve hours* the barometer at Bluff has fallen to 29·75, and has a third time commenced to rise, wind again changing to the south of west; and by the *ninth* day pressure has increased to 29·90, but it has decreased at Wellington to 30·02, wind backing about four points, while pressure has steadily increased to 30·30 at Hokianga; during the next *twenty-four hours*, the second and first binding-lines are shown to have passed the southern extreme of the colony, and the barometer has risen at all stations, being now 30·15 at Bluff, 30·08 at Wellington, and 30·30 at Hokianga, all with winds from southward. The third depression is seen to the eastward of the South Island; the barometer continues steadily rising; and by the *eleventh* day the first binding-line is shown to the eastward of Wellington, and pressure has increased to 30·25 at Bluff, 30·18 at Wellington, and 30·33 at Hokianga.


NEW ZEALAND
July 7. 1879.
NORTH ISLAND
MIDDLE ISLAND
STEWART ISLAND
COOK STRAIT
FOVEAUX STRT
Previous System
No. 1
LONGITUDE EAST OF GREENWICH


NEW ZEALAND
July 8. 1879.
NORTH ISLAND
MIDDLE ISLAND
STEWART ISLAND
COOK STRAIT
FOVEAUX STRT
No. 2
LONGITUDE EAST OF GREENWICH


NEW ZEALAND
July 9. 1879.
NORTH ISLAND
MIDDLE ISLAND
STEWART ISLAND
COOK STRAIT
FOVEAUX STRT
28.86
No. 3
LONGITUDE EAST OF GREENWICH

To illustrate Paper by Capt Edwin, on N.Z. Weather forecasts.

WEATHER REPORTS FOR 7TH, 8TH, AND 9TH JULY, 1879.

THE following detailed WEATHER REPORTS for the 7th, 8th, and 9th July, 1879, afforded the data from which the three Diagrams on Plate II. were constructed:—

NEW ZEALAND. STATION.	WEATHER REPORTS FOR JULY 7TH, 1879, 9 A.M. Barometer corrected for height.	Attached Thermometer.	Wind Magnetic.	Force 0 to 12	State of Sea.
Hokianga	29·95	53	N.E.	2	...
Russell	30·00	53	Calm.	...	...
Wangarei	29·98	53	S E.	3 to 4	...
Auckland	30·05	60	E.N.E.	2 to 3	...
Coromandel ...	30·01	50	N.E.	2	...
Manukau Head	30·02	52	N.E.	5	Smooth.
Grahamstown .	30·06	51	Calm.	...	...
Cambridge	30·00	47	S.E.	2 to 3	...
Tauranga	30·09	50	Calm.	...	Slight swell.
Taupo	30·04	47	North.	2 to 3	...
New Plymouth	29·92	55	S.E.	3 to 4	Smooth.
Opotiki	30·08	48	South.	2 to 3	Smooth.
Opunake	29·82	48	North.	1	Moderate.
Gisborne	30·06	47	N.W.	1	S.E. swell.
Wanganui	29·96	48	N.E.	2 to 3	...
Napier Spit ...	30·15	50	Calm.	...	Slight swell.
Nelson	30·03	49	Calm.	...	...
Wellington	29·95	54	Calm.	...	...
Castlepoint......	29·98	48	N.E.	3 to 4	Moderate swell.
Westport	29·85	47	S.E.	2 to 3	Moderate sea.
Tophouse	29·87	40	North.	5	...
Kekerangu	29·83	42	N.N.W.	4 to 7	Hvy. East'ly sw.
Kaikoura	29·82	43	Calm.	...	Slight swell.
Hokitika	29·77	49	N.E.	4 to 6	Modte. N.W. sea.
Lyttelton	29·85	50	N.E.	4	...
Bealey	29·77	46	N.W.	3	...
Timaru............	29·77	56	North.	2 to 3	Smooth.
Oamaru	29·89	46	West.	2 to 3	Smooth.
Naseby	29·86	31	Calm.	0	...
Roxburgh	29·65	42	N.W.	5 to 6	...
Port Chalmers	29·79	55	N.W.	7 to 8	...
Queenstown ...	29·68	35	North.	2 to 3	...
Balclutha	29·68	34	N.E.	5 to 6	...
Blenheim	30·06	50	West.	1 to 2	...
Bluff	29·58	39	N.N.E.	1	...

NEW ZEALAND. STATION.	WEATHER REPORTS FOR JULY 8TH, 1879, 9 A.M. Barometer corrected for height.	Attached Thermometer.	Wind Magnetic.	Force 0 to 12.	State of Sea.
Hokianga	29·60	54	Calm.	...	...
Russell	29·63	56	Calm.	...	Smooth.
Wangarei	29·57	53	S.W.	3	...
Auckland	29·62	58	Calm.	...	...
Coromandel ...	29·55	47	Calm.	...	...
Manukau Head	29·70	54	N.W.	3	Smooth.
Grahamstown .	29·62	56	N.W.	1 to 3	...
Cambridge	29·65	52	N.E.	2 to 3	...
Tauranga	29·65	56	N.W.	2 to 3	Heavy swell.
Taupo	29·58	54	North.	2 to 3	...
New Plymouth	29·52	56	North.	2 to 3	Heavy.
Opotiki	29·66	58	N.W.	5 to 6	Heavy.
Opunake	29·45	54	N.N.W.	1 to 2	Moderate.
Gisborne	29·62	52	North.	2	Smooth.
Wanganui	29·53	57	Calm.	...	...
Napier Spit ...	29·67	54	Calm.	...	Slight swell.
Nelson	29·53	59	Calm.	...	...
Wellington	29·45	59	Calm.	...	...
Castlepoint......	29·50	52	N.E.	2 to 3	Rough.
Westport	29·46	52	North.	2 to 3	Considerable sea.
Tophouse	29·49	45	Calm.	...	...
Kekerangu	29·36	52	N.E.	2 to 4	Easterly swell.
Kaikoura	29·27	50	N.E.	2	Heavy.
Hokitika	29·35	48	N.E.	2	Moderate.
Lyttelton	29·28	55	N.E.	1	Easterly sea.
Bealey	29·38	38	N.W.	5 to 6	...
Timaru............	29·20	42	Calm.	...	Considerable sea.
Oamaru	29·18	47	Calm.	...	Slight swell.
Naseby	29·24	39	Calm.	...	...
Roxburgh	29·14	45	Calm.	...	...
Port Chalmers	29·12	52	N.E.	2 to 3	...
Queenstown ...	29·21	38	N.E.	2 to 3	...
Balclutha	29·12	40	S.W.	2 to 3	River low.
Blenheim	29·41	52	N.E.	2 to 3	River low.
Bluff	29·11	44	N.E.	2 to 3	...

NEW ZEALAND. STATION.	WEATHER REPORTS FOR JULY 9TH, 1879, 9 A.M. Barometer corrected for height	Attached Thermometer.	Wind Magnetic.	Force 0 to 12.	State of Sea.
Hokianga	29·61	54	W.S.W.	5	...
Russell	29·60	53	S.W.	3	Smooth.
Wangarei	29·64	56	S.E.	4	...
Auckland	29·57	59	Calm	...	...
Coromandel ...	29·54	52	West	3 to 5	...
Manukau Head	29·60	52	W.S.W.	5	Rough.
Grahamstown .	29·52	51	W.S.W	6	...
Cambridge	29·45	48	Calm	...	...
Tauranga	29·51	51	West	2 to 3	Smooth.
Taupo	29·44	50	S.W.	8 to 9	...
New Plymouth	29·43	52	S.W.	3 to 4	Rather heavy.
Opotiki	29·48	51	N.W.	2 to 3	Moderate.
Opunake	29·38	52	S.W.	3 to 4	Rough.
Gisborne	29·38	49	N.W.	2	Smooth.
Wanganui	29·42	54	West	5 to 6	...
Napier Spit ...	29·42	59	Calm	...	Smooth.
Nelson	29·29	49	Calm	...	...
Wellington	29·30	58	N.W.	2 to 3	...
Castlepoint......	29·25	48	S.W.	3 to 4	Moderate swell.
Westport	29·44	48	S.E.	2 to 3	Considerable sea.
Tophouse	29·40	41	South	3	...
Kekerangu	29·23	53	S.S.W.	2 to 3	Slight swell.
Kaikoura	29·24	46	East	1	Slight swell.
Hokitika	29·34	43	East	2 to 3	Considerable sea.
Lyttelton	29·22	50	Calm	...	Smooth.
Bealey	29·38	37	N.W.	2	...
Timaru............	29·14	46	Calm	...	Slight S.E. swell.
Oamaru	29·16	48	West	3 to 4	Smooth.
Naseby	29·20	40	N.W.	2	...
Roxburgh	29·18	50	N.W.	2	...
Port Chalmers	29·14	46	N.W.	3 to 4	...
Queenstown ...	29·23	39	N.W.	2 to 3	...
Balclutha	29·11	30	West	2 to 3	...
Blenheim	29·29	52	West	3 to 4	River low.
Bluff	29·12	46	W.N.W	7	...

Art. V.—*On the Ignorance of the Ancient New Zealander of the Use of Projectile Weapons.* By Coleman Phillips.

[*Read before the Wellington Philosophical Society*, 22nd *November*, 1879.]

Mr. W. Colenso, in a paper contributed to the Hawke's Bay Philosophical Institute last year, headed as above,* replies at some length to a short paper I had the honour of reading before the Wellington Philosophical Society during the Session of 1877,† entitled, "On a peculiar Method of Arrow Propulsion as observed amongst the Maoris." Mr. Colenso's paper appears to me worthy of the greatest consideration, and I readily forgive his somewhat discourteous allusions to my remarks, seeing that I have been led to enquire more fully into a subject of so much interest. I propose in the following paper to add to the authorities quoted by Mr. Colenso, and set out the further knowledge we possess of the use of the bow and arrow among other savage nations. We may thus be able to deduce, from so many scattered facts, some ethnological analogy concerning the "Whence of the Maori."

I must confess, however, that, in my opinion, far too much importance has been attached, by purely local writers, to this question. Had any one of these writers travelled among and seen the different sections of the Malayan or Papuan races, inhabiting the South Sea Islands, he would not have exalted the question of the "Whence of the Maori" into the position to which he has exalted it. Mr. Colenso, who fairly enough represents this party, takes me severely to task for having ventured to say, in effect, that the Maori was merely one of those sections, and that his ancestry would be found among some of the people inhabiting one of the Pacific groups of islands. I imagine that I am justified in making such a statement. Professor Owen, in May last, when reading a paper before the Royal Colonial Institute on the extinct animals of the Colonies of Great Britain,‡ observed:—"When the Maori first landed he found no kangaroo or other herbivorous beast to yield him flesh. The sole source of that food—the more needed from the absence of the bread-fruit and cocoanut trees, *which he had left at Hawaii*, and the colder climate of the land to which he had been driven—was in the various kinds of huge birds incapable of flight." And again, when referring to the Australian dingo:—"With the remains of the extinct birds of New Zealand, I have received evidences of the dog of the Maoris, and abundant proofs, in ancient cooking pits, of their contemporaneity with species of *Dinornis*. But I have found nothing to affect the inference that the Maoris brought with them in their canoes, *when they first came to New Zealand*, their dogs as well as their wives and children." Such

* Trans. N.Z. Inst., Vol. XI., p. 106. † Trans. N.Z. Inst., Vol. X., p. 97.

‡ Trans. Royal Col. Inst., 1879.

explicit sentences, coming from so great an authority, sufficiently excuse me for having thought and written in a similar strain.

Moreover, I do not think Mr. Colenso justified in treating so severely my modest enquiry. It appears to me that in opening this very question of the use of the bow and arrow by the Maori, I am likely to be of more service in settling the vexed question of the original *habitat* than the pages of speculative theory before now given to us. One ounce of fact is worth more than a pound of theory. Following out such particular questions as the use of the bow or other warlike implement, the construction of language, the mode of sepulture, or other habits and customs of any savage race, are the ounces of fact, and Mr. Colenso himself admits the incompleteness of his own essay, to which I referred in my first paper, upon the particular ounce, the use of the bow and arrow. In causing him to explain his rather loose sentence, touching the manner in which the Maoris projected their fiery-headed darts when attacking a *pa* (a similar custom prevails in Fiji), I think I have been of service.

I am sorry also to point out that Mr. Colenso has much disappointed me by the use of the word "ancient" in the heading of his paper. While respecting him as one of the chief authorities in New Zealand upon Maori manners and customs, I still think that he has not been sufficiently particular in his use of terms. What does he mean by the word ancient? Surely not the New Zealander referred to by Professor Owen, who "upon landing found only huge kinds of birds incapable of flight." The whole line of his argument tends to observations made by Captain Cook and later authorities. For all any commentator can say or prove, the true *ancient* New Zealander might have brought the bow and arrow with him, but finding it of little service, and having little inclination to use it in play, soon abandoned its use and manufacture. (This is not the only thing the modern Maori has forgotten. He appears also to have forgotten the existence of the Moa, and thought its bones those belonging to a great eagle, while we are pretty well assured that the ancient Maori feasted upon it.) Yet this reasonable supposition could never be entertained, for its mere consideration would cut the ground from beneath the feet of the speculators. They would have to admit the likelihood of the truth of the traditions of the various migrations and disembarkations from the different canoes, together with the similarity of language to that of Tahiti, and other habits and customs similar to those of the South Sea Island people, and that the Maori actually did come to New Zealand from some one of these islands. The fashion has become not to admit this sensible deduction, but to surround the origin of the Maori in mystery, if not almost to exalt him into the position of a separate and distinct race. Unfortunately for such reasoners, their argu-

ments are so loose that they hardly bear criticism. They neither induce nor deduce anything, but weakly mix both lines of argument. Broadly, I, with others, think and assert that the Maori originally came from some one of the South Sea Islands, and support the assertion by deductive reasoning; pointing, in proof, to the traditions, similarity of language, etc., etc. The only other course open is to oppose the assertion, and reason inductively fact by fact to any given point, or at least to show that my facts do not support the original supposition. The speculators adopt neither course, and Mr. Colenso contents himself with asking, "Where did Mr. Phillips get the idea that the bow and arrow was the familiar weapon of the Maori ancestry?" It will be quite time to ask such a question when Mr. Colenso is prepared to show that the original deduction (the migration) is erroneous.*

I am also surprised at the following sentence contained in Mr. Colenso's paper (p. 110):—"My own testimony is this (the same indeed as that of Cook and others) *that the New Zealander never knew the use of the bow and arrow, nor of the sling proper* (the italics are his own), as used, for instance, by the natives of Tahiti." Such a sentence, without a shadow of proof, coming from so great an authority is remarkable. I am quite convinced that Captain Cook would never have so committed himself: while I am fully prepared to admit that the modern Maori—let us say, since the time of Tasman—appeared to know nothing of the bow and arrow, I cannot, nor do I think any one else will, agree in saying that the *ancient* New Zealander, the immediate descendant of one of the partakers in the migration to which tradition so definitely points, was also in a similar state of ignorance. Indeed I am inclined to take quite the opposite view, and say that the New Zealander did once know the use of the bow and arrow, and I shall endeavour to prove so grave a statement. That proof will be as follows:—Polynesia may be roughly divided into East and West. The Western tribes (Papuan and Malay) used and still use the bow and arrow as a weapon of war. The Eastern tribes (Malay) used and still use it either sacredly or in sport. The Maoris evidently came from the East. On landing they found little use for their sportive weapon, the remembrance of which perhaps, and not the weapon itself, they alone brought with them. They consequently soon abandoned its manufacture. In their original home they had never been accustomed to see the bow and arrow used, except sacredly or in sport. A few tribes, in shallow waters, upon coral reefs, used and still use the bow and arrow for shooting fish, but there were no coral reefs, with like advantages, to be found in New Zealand. I am, therefore, entitled to consider that the ancient New Zealander once knew the use of a sacred and sportive weapon, the remembrance of which, the circumstances attending a new

* See note A.

domicile, and the physical features and animal life of a new country, induced him to forget. It will doubtless surprise the speculators above referred to to learn that this very forgetfulness, as a deductive argument, is only further proof of the soundness of the original deduction.

Moreover, Mr. Colenso, in his reference to Dr. Forster's remarks * upon the use of the bow and arrow by the Tanna people, is likely to mislead the incautious reader. The Island of Tanna forms one of the New Hebrides group, lying slightly to the westward of the longitude of New Zealand, and about 1600 miles immediately to the northward. Its inhabitants are a mixed race (Papuan and Malayan). As I have already said the bow is a familiar weapon of war among the Papuans, let no one suppose for a moment that the Maoris came from any of their islands. The ordinary course of the trade winds and great storms effectually prevents any such means of communication. Dr. Forster's remarks are, therefore, quite inappropriate. So also with regard to the natives of New Caledonia. The trade winds blow direct from a little to the north of New Zealand *towards* New Caledonia, nine months out of the year, the rest of the year being the hurricane season. (Sydney sailing vessels, in order to reach New Caledonia, have first to pick up the longitude of New Zealand). Now the general feature of the South Sea Island canoe is to run before the wind, though an oblique course can be steered by keeping as close to the wind's eye as the sailing properties of the particular craft allow. It would have been almost an impossible task to *tack* down to New Zealand from Tanna or New Caledonia. Both of these examples are therefore quite beside the question at issue. Tanna must not be confused with Tonga, for Tonga and the Tongese occupy quite a different position, and a north-easter might easily have sent a canoe load of warriors down to the Kermadec Islands, and so on to New Zealand.†

I desire also to point out that the heading of my paper contains the words "*peculiar method of propulsion.*" This peculiarity was the one important feature of the paper, and sufficient attention has hardly been given to it. Whether the Maori knew or did not know the use of the bow was quite secondary to the chief question—peculiarity of propulsion. I have enquired of old natives in the Wairarapa concerning the matter, and shown them the arrow and whip. While expressing ignorance of the former, they readily applied the whip to a raupo stick to cast it in sport. As I know of no similar method of propulsion existing among civilized nations, I think we should all feel favoured by Mr. Colenso more carefully enquiring into its origin.

With regard to the use of the bow and arrow among other savage nations, I gather that it is or has been used as follows :—And first, with regard to

* *Loc. cit.* Appendix A, p. 114. † See Note B.

Polynesia. I have before stated that the Eastern Polynesians make but little use of the weapon, while the Western Polynesians always use it as a weapon of war. This difference is readily accounted for if we turn to the various tribes inhabiting the Malay Islands, the original habitat of all the Polynesian islanders. There are four great races in Malaysia possessing various degrees of civilization and great difference of language, and three or four savage races. The first are the Malay proper (inhabiting the Malay peninsula, and the coast regions of Borneo and Sumatra); the Javanese; the Bugis; and the Talagese. The savage races comprise the Dyaks (wild tribes of Borneo), Battaks, Jakuns, and the aborigines of Northern Celebes, Sula Island, and part of Bouru. These various peoples have, at different times, migrated, or been driven to migrate, and naturally carried their different customs with them. Some used the bow and arrow sacredly or in sport, some as a weapon of war, and some the poisoned arrow. Western Polynesia has evidently been peopled by the wild Malay tribes, or Papuans, who use the war or poisoned arrow; while Eastern Polynesia has evidently been peopled by the long-haired, more civilized, Malayans, who were not so savage and warlike.

With reference to the statement that archery was a sacred game:—Mr. Ellis, in his Polynesian Researches * gives the following account of the matter as observed in Tahiti:—

"The *te-a*, or archery, was also a sacred game, more so perhaps than any other. The bows, arrows, quiver and cloth in which they were usually kept together with the dresses worn by the archers, were all sacred, and under the especial care of persons regularly appointed to keep them. It was usually practised as a most honourable recreation between the residents of a place and their guests. The sport was generally followed either at the foot of a mountain or on the sea-shore. My house in the valley of Haamene, at Huahine, stood very near an ancient *rahi te-a*—place of archery. Before commencing the game, the parties repaired to the marae, and performed several ceremonies; after which they put on the archer's dress, and proceeded to the place appointed. They did not shoot at a mark; it was therefore only a trial of strength. In the place to which they shot the arrows two small white flags were displayed, between which the arrows were directed. The bows were made of the light, tough wood of the *purau;* and were, when unstrung, perfectly straight, about five feet long; an inch, or an inch and a quarter, in diameter in the centre, but smaller at the ends. They were neatly polished, and sometimes ornamented with finely braided human hair, or cinet of the fibres of the cocoanut husk, wound round the ends of the bow in alternate rings. The string was of *romaha*, or native flax; the arrows were made of

* Vol. I., p. 229.

small bamboo reeds, exceedingly light and durable. They were pointed with a piece of *aito*, or iron-wood, but were not barbed. Their arrows were not feathered; but in order to their being firmly held while the string was drawn, the lower end was covered with a resinous gum from the bread-fruit tree. The length of the arrows varied from two feet six inches to three feet. The spot from which they were shot was considered sacred; there was one of these within my garden at Huahine. It was a stone pile, about three or four feet high, of a triangular form, one side of the angle being convex. When the preparations were completed, the archer ascended this platform, and, kneeling on one knee, drew the string of the bow with the right hand, till the head of the arrow touched the centre of the bow, when it was discharged with great force. It was an effort of much strength, in this position, to draw the bowstring so far. The line often broke, and the bow fell from the archer's hand when the arrow was discharged. The distance to which it was shot, though various, was frequently 300 yards. A number of men, from three to twelve, with small white flags in their hands, were stationed to watch the arrows in their fall. When those of one party went farther than those of the other they waved their flags as a signal to those below. When they fell short, they held down their flags, but lifted up their foot, exclaiming, *ua pau*, beaten.

"This was a sport in the highest esteem, the king and chiefs usually attending to witness the exercise. As soon as the game was finished, the bow, with the quiver of arrows, was delivered to the charge of a proper person; the archers repaired to the marae, and were obliged to exchange their dress and bathe their persons before they could take any refreshment, or even enter their dwellings. It is astonishing to notice how intimately their system of religion was interwoven with every pursuit of their lives. Their wars, their labours, and their amusements, were all under the control of their gods." After describing the quiver, Ellis continues as follows:—"The bow and arrow were never used by the Society Islanders excepting in their amusements; hence perhaps their arrows, though pointed, were not barbed, and they did not shoot at a mark. In throwing the spear, and the stone from the sling, both of which they used in battle, they were accustomed to set up a mark, and practised that they might throw with precision as well as force. In the Sandwich Islands they are used also as an amusement, especially in shooting rats, but are not included in their accoutrements for battle; while in the Friendly Islands (Tonga) the bow was not only employed on occasions of festivity, but also used in war; this, however, may have arisen from their proximity to the Feejee Islands, where it is a general weapon. In the Society and Sandwich Islands it is now altogether laid aside, in consequence of its con-

nection with their former idolatry." (Mr. Ellis' knowledge of Tonga was very slight.)

According to Williams,* the bow does not appear to have been used by the Samoans in their numerous battles, only the sling, club, and jagged spear.

In Fiji "the bow is sometimes used by women in hard sieges. Fiery arrows are occasionally employed to burn a place into submission. The sling is wielded by powerful hands. I saw a musket which had been struck by a sling-stone. The barrel was considerably indented, and bent nearly half an inch in its length. Another weapon much used, is the missile club, which is worn, stuck in the girdle, sometimes in pairs, like pistols. It resembles the *induku* of the Kaffirs, a short stick with a large knob at one end, either plain or ornamented. This is hurled with great precision, and used formerly to be the favourite implement of assassination."†

Besides the extracts from Cook's Journal, already given by Mr. Colenso, I think it proper to add the following. Referring to the attack by the New Guinea people, in his first voyage, Cook states:—"As they ran towards us the foremost threw something out of his hand, which flew on one side of him, and burnt exactly like gunpowder, but made no report; the other two instantly threw their lances." A little further on Cook continues:—"All this while they were shouting defiance, and letting off their fires by four or five at a time. What these fires were, or for what purpose intended, we could not imagine; those who discharged them had in their hands a short piece of stick, possibly a hollow cane, which they swung sideways from them, and we immediately saw fire and smoke, exactly resembling those of a musket, and of no longer duration. The deception was so great that the people on board thought they had firearms."

In Eastern Polynesia, Cook makes but slight mention of the bow and arrow. On arriving at the Marquesas Islands he observed "a heap of stones in the bow of each canoe, and every man had a sling tied round his hand."

The conduct and aspect of the people of Savage Island caused Cook to give it that name. They threw stones and spears. No mention of the bow and arrow. At Mallicollo (New Hebrides) Cook was fired at by the natives with poisoned arrows. At Erromanga he noticed that most of the people were armed with bows and arrows. These people also threw darts and stones. The people of Tanna were all armed with the bow and arrow, darts, spears, slings, and stones. In the attack, when Cook himself fell, at Karakakora Bay, Owyhee, a dagger *(pahooa)* was the weapon which caused death, and stones the principal instruments of attack. No mention is made of the bow and arrow by Captain King, Cook's coadjutor.‡

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* Missionary Enterprises in the South Sea Islands, p. 531.

† Fiji and the Fijians, by Williams and Calvert, p. 44.

‡ The dagger (*kris*) is the national Malay weapon.

Hardly any reference is made to the bow by Messrs. Tyerman and Bennett; yet a striking fact is alluded to by them. In observing a conversation between the natives of Tahiti, whom they took with them to the Sandwich Islands, and these latter people, they remark "that the dialects of both nations are so nearly akin that the natives can converse very well with one another."* In the Island of Silo (qy. Sooloo), Malaysia, Messrs. Tyerman and Bennett record having noticed the following amusement:—† "The girls, who had hitherto been engaged in dancing, now retired, and another company made their appearance dressed like the former (peculiar dresses). When they were all seated, an old woman entered and laid down at the feet of each, an instrument resembling a bow, with an arrow on the string, about two feet long, lacquered red and decorated with gold. The dancers soon afterwards rose, and went through all the evolutions of the others, holding these bows in their hands, which added exceedingly to the beauty and picturesque effect of their groups and attitudes."

The Rev. J. Turner, speaking of arrows, observes in his illustrations of Scripture, "*Arrows* . . . the poison whereof," etc.—Job vi. 4:—"Arrows, so often referred to in Scripture, are still in use in the South Seas, principally where firearms have not been introduced. They are made of a piece of reed, three or four feet long, pointed or barbed, with a bit of hard wood. In the New Hebrides we find them pointed with a piece of human bone, and sometimes dipped in poisonous mixtures from the bush."‡ As a general rule the people of Western Polynesia use poisoned arrows.§

In Asia the bow and arrow is used by the Samoiedes, a people resembling the American Indians, and inhabiting the great Siberian promontory, ending in Cape North; the Khalkas, the most important tribe of the Eastern Mongols; the Buriäts and Yakuts (Siberians); the Siamese, who use powerful cross-bows and poisoned arrows for big game; the Andaman islanders; the Dyaks (Malay), who also use poisoned arrows.

I may here be allowed to refer to the use of the sumpitan. The sumpitan is a curious arrow-adaptation. The arrow is blown from a pipe seven to eight feet long. The Kayans (Dyaks) carry the arrows in a bamboo case, hung at the side, and at the bottom of this quiver is the poison of the upas. The arrow is a thin piece of wood, sharp-pointed, and inserted in a socket, made of the pith of a tree, which fits the tube of the blow-pipe. Beyond a distance of twenty yards they do not shoot with certainty, from the lightness of the arrow. On a calm day the utmost range may be a hundred yards.||

* Voyages and Travels, Vol. I., p. 378. † Vol. II., p. 214.

‡ Nineteen Years in Polynesia, p. 311. § Murray: Missions in Western Polynesia.

|| Borneo and Celebes.—Brooke.

In Crawford's "Indian Archipelago" occurs the following passage:—
* "Among the savages of all nations we find the use of the club, the sling, and the bow and arrow, the first and universal weapons of all mankind.† To these the Indian islanders add the tube for discharging arrows, which are sometimes poisoned with a prepared vegetable juice. The Balinese are the only tribe, in any degree civilized, which retains the general use of this practice. The more powerful nations have long since given it up, we may presume rather from an experience of its inefficacy, than from any conviction of the immorality or baseness of the practice. The Javanese historians, in rendering an account of a war conducted by the Sultan of Mataram, against the people of Bali and Blamlangan, as long ago as the year 1639, mention the use of poisoned arrows on the part of the former, as an extraordinary circumstance new to their countrymen, and which excited at first some alarm. In the use of the bow and arrow, and the sling, I do not discover that the Indian islanders have acquired any extraordinary dexterity. The Javanese are extremely fond of the exercise of the bow and arrow as an amusement (sitting, not standing, when drawing the bow), but are anything but skilful in the use of it, and seldom succeed in throwing the arrow above a dozen yards. In the attack upon the palace of the Sultan of Java, in 1812, the Javanese threw stones from slings in great numbers, but without inflicting a serious wound, or even dangerous contusion, in the period of two days. The knowledge of iron must soon have in a great measure suspended the use of these less perfect weapons, and given rise to that of the spear and kris. These may be justly styled the favourite weapons of the Indian islanders." That arrows were once freely used, is shown in the romances founded by the Javanese on Hindu story or mythology.‡

In Africa the bow is used by the Nubians—whose women twist the hair into the numberless tiny plaits commonly seen among the Western Pacific islanders—the Hottentots or Bushmen who use the barbed and poisoned arrow, and other tribes, authorities for whose names I have not consulted. Livingstone, in one of his works,§ gives the following:—
"Poisoned arrows are made in two pieces. An iron barb is firmly fastened to one end of a small wand of wood, ten inches or a foot long, the other end of which, fined down to a long point, is nicely fitted, though not otherwise secured, in the hollow of the reed, which forms the arrow-shaft. The wood, immediately below the head, is smeared with the poison. When the arrrow is shot into an animal the reed either falls to the ground at once,

* Vol I, p. 222.

† Note.—This does not appear to apply to the people of Australia or the Esquimaux.

‡ Crawford: Vol. II., p. 25. § "The Zambesi," p. 466.

or is very soon brushed off by the bushes; but the iron barb and poisoned upper part of the wood remain in the wound. The poison used here, and called *kombi*, is obtained from a species of *Strophenthus*, and is very virulent." "Another kind of poison was met with on Lake Nyassa which was said to be used exclusively for killing men. It was put on small wooden arrow-heads and carefully protected by a piece of maize leaf tied round it." (The New Hebrideans wrap a piece of banana or other leaf round the heads of their poisoned arrows.) Further on (p. 556) Livingstone continues:—"A bow is in use in the lower end of Lake Nyassa, but is more common in the Maravi country, from six to eight inches broad, which is intended to be used as a shield as well as a bow."

To what extent the bow was used in Madagascar, I cannot say, authorities being very slight. I shall be glad if any of my hearers can inform me. It is an interesting question, "the Malagese (people of Madagascar) being a Malay people following Malay customs, some of them possessing Malay eyes and hair and features, and all of them speaking a Malay tongue at the present hour."*

In South America the bow is used by the Antis Indians inhabiting the Bolivian Andes, who use the three-pronged arrow for fishing, like many tribes in the South Seas; the Pecheray Indians, inhabiting both shores of the Straits of Magellan; the Tierra del Fuegians, whose bows and arrows were much admired by Cook; the Lenguas, a remnant of a great Indian nation; the Tobas, and other neighbouring tribes of the great Desert, who pierce the lobe of the ear and extend the orifice to an immense size for purposes of ornament, like numerous South Sea tribes under the equator, a custom which the Maoris still follow, (many black nations of the Nile pierce the lower lip for a similar purpose, and the Zambesi negroes pierce and extend the upper lip); the Payaguas, the warlike neighbours of the Paraguayan Republic; and I believe also the Botocudos of Brazil, who pierce both ear and lip, and enlarge each orifice. The tribes of Indians dwelling near the Amazon were also, I believe, accustomed to use the blow-gun and poisoned arrows for killing game, exactly similar to those used in Malaysia. The tube was about ten feet in length, and the arrow fifteen to eighteen inches.

Generally by the North American Indians, who found great use for the bow for all purposes of war and chase. The Iroquois, Sioux, Commanche, and Crow Indians, all used this weapon, and the Indians as far north as Queen Charlotte Sound.

I can find no mention of its use among the Esquimaux, one of the most widely-spread nations of the world, inhabiting a coast-line of over five

* Mullens' "Twelve Months in Madagascar," p. 176.

thousand miles. I much regret my inability, authorities differing so greatly in the origin of this race.

Although the natives of Australia are surrounded by savage nations using the bow and arrow, Cook did not observe any such weapons among them, only lances and darts, thrown by hand or with a throwing-stick.

I have sufficiently trespassed upon my hearers' attention, and I must ask to be excused for the length of the paper. It is only by following out the particular customs of savage tribes, and investigating the construction of their language, that the cradle of birth of any particular *gens* can be ascertained. I trust Mr. Colenso will, at some future day, favour us with a paper, setting out more minutely than he has even yet done, the manners and customs of the Maoris. A higher civilization is wiping away the habits of a more barbarous time, yet to the ethnological student, these habits, manners, and customs are deeply interesting.

Note A.

I may be allowed to refer briefly to various matters in which the Maori resembles Eastern Polynesians. The shape and carving of the New Zealand war-clubs exactly resembles those in use among numerous Pacific Island tribes. Their custom of *taboo* is exactly similar. In the mode of burying the dead, some of their customs, especially that of wrapping the body in mats, were similar. Their method of wearing mats, and working ordinary basket-kits, is the same. Their mode of mourning—cutting the hair and gashing the body—is alike. Their traditions all point to a migration, or migrations at different times, from one or other of the South Sea Islands. Their language is alike. Their great god *Maui* is but the god of the Sandwich Islands. Their method of house-building is alike. Also painting the body. The custom of *tattoo* is more severe (the Marquesas excepted) than in any other Pacific Island. The very word *tattoo* is similar in many islands (it evidently is derived from the Tongese verb *ta*, to strike.) The use of the waist-cloth is common. Their adzes are alike, so are their drinking calabashes. In the habits of cannibalism they but resemble their ancestry. Their mode of fastening the carved head-work of a canoe to the sides is exactly similar to South Sea practice. The Church Missionary Society's Museum contains models of single and double canoes exactly similar to those found in the Pacific. Carvings, houses, and all their war-pahs were generally erected upon an eminence. Cruise refers to one erected at Wangaroa situated upon an eminence 300 feet high. I have seen exactly similar forts in Fiji. The word *pa* or *pah* is the very word used by the people of the Hervey Group, if I remember correctly. The Sandwich Islanders, in Cook's days, were in the habit of saluting visitors by crushing

noses, as is still the custom among the Maoris. I believe the Maori used the nose-flute in common with the Tongese and Tahitians:—"The scrupulous regard which the natives of New Zealand pay to the graves of their dead is equally observed among the Sumatrans, and the native clothing of the latter people is precisely the same, both in texture and material, to that worn by the Otaheitans, and which is made of the papyrus tree."* With respect to the language, Mr. Nicholas remarks:†—"The subjoined vocabulary was compiled by Mr. Kendall previously to my departure from New South Wales, at which place it has been printed by order of Mr. Marsden, who sent several books of it to New Zealand for the instruction of the children there. The compiler derived considerable assistance from a copious collection of words in the Otaheitan language, with which he was furnished by one of the missionaries who had resided for some years at Eimeo. This collection formed a vocabulary of nearly 2,000 words, the greater number of which had so close an affinity to those of New Zealand that Mr. Kendall found it necessary to make but little alteration in the most of them, and in some not at all. The genius and construction of the two dialects appear to be perfectly the same, and the like identity is observable in the extensive vocabulary of Tonga words collected by Mr. Mariner."

English.		New Zealand.		Tonga.
1	..	Kotahi	..	Ta'ha.
2	..	Kadooa	..	Oo'a.
3	..	Katoodoo	..	To'loo.
4	..	Kawha	..	Fa.
5	..	Ka-deema	..	Nima.
6	..	Ka-hunnoo	..	Ono.
7	..	Ka-whittoo	..	Fi'too.
8	..	Ka.wháddoo	..	Va'loo.
9	..	Ka-hewha	..	Hi'va.
10	..	Kanghahoodoo	..	Ongofoo'loo.
20	..	Katikow manahoodoo	..	Tecow.

Note B.

It was not at all an infrequent thing, in the good old times, for a great canoe, with its hundred warriors, to leave Tonga and sack a town in Samoa or Fiji, 400 miles distant; but those times have passed away. The Kermadecs are only about 600 miles south of Tonga, and New Zealand 800 miles. I have seen many a Tonga man whom I might readily have mistaken for a Maori. This statement also applies to the Samoans. A Samoan fish-hook and a Maori fish-hook are exactly the same, both in form and material, yet this very tool is of a most remarkable plan and construction, so much so that for two separate and distinct tribes to hit upon the like idea is not at all

* Nicholas, Vol. II., p. 287. † Vol. II., p. 323.

probable. From my knowledgo of the South Seas, I have often been inclined to consider that the Maoris, Tongese, Samoans, Rarotongans, and Hervey Islanders are all sprung from the same tribe, and that their islands were originally peopled from Tahiti. Often indeed, even now, Tahitian canoes are driven a three weeks' journey to the westward, or westward and southward, the people, happening to be in them, living upon a few cocoa-nuts as long as such a supply lasted. Also, that Tahiti itself may have been peopled by a migration from the Sandwich Islands, unless indeed these two groups of islands were peopled at one and the same time by a migrating tribe from the parent Malay country. It is, however, a strange circumstance, that nearly all these islanders claim some acquaintance with Hawii, the principal island of the Sandwich group, the Savii (=Tharii) of Samoa being almost similar in pronunciation, and the Hauraki of New Zealand being a derivative. The Hawaiian mythos pervades the different groups, especially, as I have before said, the deeds of the great god Maui. I might indeed go further, and say that the natives of all the islands of Eastern Polynesia are sprung from the same origin, and in support of this statement I attach a comparative view of the numerals of the different dialects that I have taken from a table compiled by the Rev. G. Turner, LL.D., to which I refer my hearers :—*

	Marquesas.	Tahiti.	Sandwich or Hawaii.	Rarotonga.	Manahiki.	Samoa.	Savage Island.	Union Group.	Tonga.	New Zealand.
1	Tahi	Tahi	Kahi	Ta'i	Tahi	Tasi	Taha	Tasi	Taha	Tahi
2	Ua	Rua	Alua	Rua	Lua	Lua	Ua	Lua	Ua	Rua
3	Tou	Toru	Akolo	Toru	Toru	Tolu	Tolu	Tolu	Tolu	Toru
4	Fa	Ha	Aha	A	Fa	Fa	Fa	Fa	Fa	Wha
5	Ima	Rima	Alima	Rima	Lima	Lima	Lima	Lima	Nima	Rima
6	Ono	Ono	Eono	Ono	Ono	Ono	Ono	Ono	Ono	Ono
7	Fitu	Hitu	Ahiku	Itu	Hitu	Fitu	Fitu	Fitu	Fitu	Whitu
8	Vau	Varu	Aualu	Valu	Varu	Valu	Valu	Valu	Valu	Waru
9	Iva	Iva	Aiwa	Iua	Iva	Iva	Iva	Iva	Hiva	Iwa
10	Onohu'u	Ahuru	Umi	Ngaulu	Laungahulu	Sefulu	Hongofulu	Sefulu	Hongafulu	Ngahuru
20	Eu'a onohu'u	Ta'au	Iwakalua	Elua nga ulu	Takau	Luafulu	Ua hongofulu	Luafulu	Luofulu	Rua tekau
100	Au		Umiumi	Lau	Lima takau	Selau	Te au	Selau	Te au	Rau
1,000	Mano			Mano	Ua lau	Afe	Afe	Afe	Afe	Mano
10,000					Mano	Mano		Mano	Mano	

The reason that the numerals of the Union Group (Bowditch Island) happen to be so exactly like those of Samoa, arises, I believe, from the fact that Samoans colonized the group. The same reasoning applies to Savage Island and Tonga. The only other islanders in the Pacific whose numerals

* "Nineteen years in Polynesia."

approach in similarity, are the Rotumah people and those of the Islands of Niua and Vate in the New Hebrides (evidently colonies driven or migrated from the East). The numerals afford a good example of the language. The dissimilarity between the Hawaiian and the other dialects proves in a measure the originality of the former and the connection with each other of the latter.

ART. VI.—*On the Moa.* By W. COLENSO, F.L.S.
Plates IV. and V.

[*Read before the Hawke's Bay Philosophical Institute*, 10*th June*, 1878, *and* 13*th October*, 1879.]

FOR some time past I have been thinking of bringing this interesting subject before you, and that for several reasons.

1. Because this animal is purely a New Zealand one, and not only so, but it is, I think I may safely say, to be classed among the animal wonders of the world.

2. Because here in Hawke's Bay (Napier) but little is known of it—nothing indeed when compared with Christchurch, Wellington, and other towns, where also fine specimens of its entire skeleton may be seen in the Museums.* I believe that I may fairly infer, that not a few of you present have not yet heard any account of it—never yet seen any of its bones, save these which I now lay before you, † much less an entire mounted skeleton, such as are in those photographs, now on the table, procured from Christchurch.

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* Here in Hawke's Bay, during the whole term of my residence (over 35 years), but very few bones of the *Moa* have been found, and those singly, scattered, and broken. Nevertheless, on one occasion, about twenty years ago, the men at work on the Middle Road (between Havelock and the entrance to the Kaokaoroa Valley), in making a cutting in the side of a hill, found, either the whole skeleton of a large *Moa*, or the bones of several all together, deeply embedded among or under the limestone. I did not hear of it until some time after, and, on my visiting the spot, I found that the whole of the bones had been smashed up and mixed with the clay and limestone from the cutting where they were found; in fact many of them fell to pieces on being exposed to the sun and air. I obtained, however, a few small pieces of the shank of a tibia and of a tarsus, which were of remarkable thickness, I think the thickest by far that I had ever seen. They had been partly converted into a kind of lime, and were wholly as white as the impure limestone in which they were found, and scarcely at first sight distinguishable from it. A few years ago a fine specimen of a tibia, in fair preservation, measuring two feet eight inches, was found near Patangata: this I now have.

† These were, a pair each of Femora, Tibiæ, and Tarsi, all from one *Moa*, found *in situ*, with other bones, at Poverty Bay, about thirty years ago. The tibiæ measure two feet five inches each, and the whole are in excellent preservation.

3. Because I diligently sought after it, and wrote very early about it, before New Zealand became a colony, in 1838-1842; and yet, though that early paper had been *twice* published, both in Tasmania and in England, I do not think there is a single copy in the Colony save my own. Indeed, I have failed to procure one at any price in London.

4. Because that early-written paper on the *Moa* has been frequently referred to and quoted in many scientific works published in Europe and America, as well as by Dr. Von Haast in the volumes of the "Transactions of the New Zealand Institute" in our Library.

5. Because I have been subsequently repeatedly written to, appealed to, and importuned, both from Europe and within the Colony, respecting what I had published, and also asked to add to what I first made known about it.

6. Because I have, during the past few years, been again seeking from every possible source to gather up anything that was left concerning the *Moa*.

Those are among the chief reasons which incline me now to bring this subject before you. I think you will agree with me as to their validity.

I propose, therefore, to divide my paper into two parts—1. What I originally wrote on the *Moa* (which being wholly unknown to you will be new); and 2. To bring before you all additional information which I have subsequently gleaned respecting it.

Part I.—*What I originally wrote on the Moa.*

"*An Account of some enormous Fossil Bones of an unknown Species of the Class Aves, lately discovered in New Zealand.*"*

During the summer of 1838, I accompanied the Rev. W. Williams on a visit to the tribes inhabiting the East Cape district. Whilst at Waiapu (a thickly inhabited locality about twenty miles S.W. from the East Cape), I heard from the natives of a certain monstrous animal; while some said it was a bird, and others "a person," all agreed that it was called a *Moa*; that in general appearance it somewhat resembled an immense domestic cock, with the difference, however, of its having a "face like a man;" that it dwelt in a cavern in the precipitous side of a mountain; that it lived on air; and that it was attended or guarded by two immense *Tuataras*,† who, Argus-like, kept incessant watch while the *Moa* slept; also, that if any one ventured to approach the dwelling of this wonderful creature, he would be invariably trampled on and killed by it.

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* My first paper was written early in 1842, and published with two plates of bones of the Moa in the "Tasmanian Journal of Natural Science," Vol. II., part 7: this was subsequently republished in England, by Professor Owen, in the "Annals and Magazine of Natural History," Vol. XIV., p. 81, with the above title.

† See Note A, Appendix I.

A mountain named Whakapunake, at least eighty miles distant in a southerly direction, was spoken of as the residence of this creature; here, however, only one existed, which, it was generally contended, was the sole survivor of the *Moa* race. Yet they could not assign any possible reason why it should have become all but extinct.

While, however, the existence of the *Moa* was universally believed (in fact, to dare to doubt of such a being amounted, in the native estimation, to a very high crime), no one person could be found who could positively testify to his having had ocular demonstration of it; for while with every one it was a matter of the profoundest credence, that belief only rested on the bare and unsupported assertion of others. Many of the natives, however, had from time to time seen very large bones; larger, from their account, than those of an ox; these bones they cut up into small pieces for the purpose of fastening to their fish-hooks as a lure instead of the *Haliotis** shell, it answering that purpose much better, from its going more equably through the water.

It was almost ludicrous, whilst at the same time it showed the powerful effect which this belief of theirs had over them, to witness their unconcealed fear, almost amounting to horror, on requesting them to go to the residence of the *Moa* to procure it, or to act as our guides thither for that purpose. Unlike, too, what has been very frequently observed in savage nations, this fear seemed not to arise from any degree of superstitious dread, but merely from an abiding conviction of the physical powers of this prodigious animal; as well as from their belief of the moral certainty of such powers being put into immediate action if they dared to intrude within the precincts of this creature's resort.

As a matter of course, I treated the whole story (so far as related to the present existence of such an animal) as fabulous; looking on it as one more of those many peculiar tales and legends which so abounded in the "olden time," and which every nation under heaven invariably possesses. I could not but think, however, what an excellent companion for the celebrated *Roc*† of oriental story and nursery fairy-tale it would have made, had it but been known a little earlier: for, however some few grown-up persons may still delight in reading such marvellous exploits, parents generally, I think, have come to the wise conclusion to prohibit their introduction to the rising generation.

On our return to the Bay of Islands, several natives from the East Cape district accompanied us. From them I subsequently received pretty nearly the same details concerning the *Moa*, as I had given me before when in that neighbourhood.

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* See Note B, Appendix I. † See Note C, Appendix I.

In the following year, 1839, the Rev. W. Williams again visited that district, accompanied by the Rev. R. Taylor. The non-arrival of the vessel by which these gentlemen were to return to the Bay of Islands, which caused them a fortnight's detention at the East Cape), afforded them much more leisure time than I had when there. Mr. Taylor, hearing of this *Moa*, prosecuted his enquiries, and was subsequently rewarded with the discovery of (what appeared to be) a part of a fossil *toe* (or rather claw) of some gigantic bird of former days.

In the summer of 1841-2, I again visited those parts. At Waiapu I gained the information, that Whakapunake (the mountain where the *Moa* was said to reside) had been visited by some baptized natives, purposely to ascertain the truth of the common belief; and which they declared to be altogether without foundation; finding neither cavern, nor lizard-guards, nor *Moa*, nor any signs of such uncommon *lusus naturæ*. But what was of far greater interest to me than this relation of theirs, were some bones which I had the good fortune to procure from them, and which were declared by the natives to be true *Moa* bones. These bones, seven in number, were all imperfect, and comprised five *femora*, one *tibia*, and one which I have not yet been able satisfactorily to determine. The largest *femur*, consisting of the diaphysis only without the processes, measured eight inches in length, and four and three-quarter inches in girth in the narrowest part. The portion of the *tibia* (which, like the *femur*, consisted only of the middle part), measured in length six inches, and in circumference four inches at the narrowest, and five inches at the widest part. The still remaining bone, the largest of all, which was merely a section, measured in length six inches, and in circumference seven and a quarter inches in the smallest part. These bones were all (excepting the last mentioned) of a very dark colour, almost a ferruginous brown, and appeared to have entirely lost their oily matter. They were very stout, especially the *tibia*, and were strongly marked and indented on the outside with muscular impressions. Within, what little remained of the reticulated cells appeared to be nearly perfect. They were all found by the natives in the Waiapu river, and were collected by them for the purpose of cutting-up and attaching to their fish-hooks, in order to fish. The portion of *tibia* which I obtained had been sawn across by the native in whose possession it was, for that purpose. I also obtained several hooks, each having portions of the bones of the *Moa* attached to it. I could not, however, ascertain, from the smallness of the slips, whether these had been originally cut out of such bones as those I had just procured, or whether they had not been sawn from bone of a different description and larger size.

Leaving Waiapu, and proceeding on by the coast towards the south, I arrived at Poverty Bay, where the Rev. W. Williams resided. This gentleman had had the good fortune to procure a nearly whole *tibia* of an immense bird, without, however, the entire processes of either end. This bone measured about eighteen inches in length, and was proportionably thick. Mr. Williams wishing to send this unique relic to Oxford, I left a pair of *femora* to accompany t, in order, if possible, to obtain from that seat of learning some light on these increasingly interesting remains. At Poverty Bay I made several enquiries after *Moa* bones, but to little purpose, as I could not obtain any.

Quitting Poverty Bay, and still travelling in a southerly direction, I soon came within sight of Whakapunake, the mountain celebrated as the residence of the only surviving *Moa*. As natives lived about its base, among whom my route lay, I looked forward with no small degree of interest to the chance of obtaining some relics of the *Moa* in this locality ; in this, however, I was disappointed. At the close of the second day's travel we arrived at Te Reinga (a village situated at the foot of the mountain), where, as opportunity offered, I enquired of the natives relative to the *Moa*. They, in reply to my reiterated queries, said that he lived there in the mountain, although they had never seen him ; still the *Moa* bones were very commonly seen after floods occasioned by heavy rains, when they would be washed up on the banks of gravel in the sides of the rivers and exposed to their view ; at this time, however, they had not any by them. I offered large rewards for any that should be found hereafter, and which were to be taken to Mr. Williams, at Poverty Bay. Here, as at Waiapu, no one person could be found who possessed the hardihood positively to assert that he had seen this *Moa*, although this neighbourhood had ever been the dwelling-place of this tribe. The mountain, too, it appeared was by no means unknown to them ; for, during a war between themselves and the Urewera tribe a few years ago, they had fled for refuge to their stronghold on the top of Whakapunake, where they had lived for some time, and where many of their relatives eventually fell into the hands of the enemy, who starved them into a surrender and took the place. Here, then, was still further proof, if proof were wanting, that no such colossal animal could possibly at this time be *existing* in this place. The spot, however, was well chosen for the fiction of such a creature's residence : a huge, table-topped and lofty mountain, covered with primæval forests of gloomy pines ; its brow singularly adorned with a horizontal stratum of whitish sandstone, which ran continuously and precipitously for more than two miles. At the base of the mountain ran the river Whangaroa, down which we paddled in canoes for some distance. This river is a branch of the Wairoa river, which disembogues into Hawke's Bay.

These natives further informed me that a *Moa* resided in a certain high mountain in Te Whaiiti district, nearly five days' journey into the interior, in a N.W. direction from the place where we now were, and that *there* I should find people who had actually seen the animal. If I was little inclined to believe in the story of its existence before, I was much less inclined to do so now; however, as my route lay that way, I noticed this information among my memoranda, determining to make every possible enquiry after it.

Fifteen days after this I arrived at Te Whaiiti, the principal village of that district, and not far from the residence of the second *Moa*. Here, however, as before, the people had never seen a *Moa*, although they had always heard of, and invariably believed in, the existence of such a creature at that place. They, too, had not any bones in their possession; though such, they said, were very commonly seen after heavy floods. The following day I passed close by the mountain where this *Moa* had resided for so many years, but noticed nothing more than usual (although I availed myself to the utmost of the use of my pocket telescope), save that this part of the country had a much more barren and desolate appearance than any I had hitherto witnessed.

I returned in the autumn to the Bay of Islands, without gleaning any further information relative to the *Moa*.

It should, however, appear (from information which I have recently received from the Rev. W. Williams), that, very shortly after my leaving Poverty Bay, a *Moa* bone was brought him by a native, which he immediately purchased. The natives in the neighbourhood hearing of a price being given for such an article as a bone, which they had ever considered as of little worth, were stimulated to exertion, and a great number, perhaps more than a hundred persons, were soon engaged in the field, actively searching after *Moa* bones; the result was that Mr. Williams soon had the pleasure of receiving a large quantity of fossil bones, some of which were of an enormous size, and in a good state of preservation. The bones, though numerous, were not in any great variety, chiefly comprising such as I have already mentioned, *i.e.*, those of the *femur* and *tibia*, together with those of the *tarsus*, the lower part of the *dorsal vertebræ*, and a portion of the *pelvis*. Altogether the bones of nearly thirty birds, apparently of one species only, must have been brought to Mr. Williams. From the great difference in the sizes of some of them when compared with each other, Mr. Williams came to the conclusion that the animal to which they once belonged must have been very long-lived. Whilst, however, I do not perceive how far this inference is to be correctly deduced from the mere difference in the size of the bones, we know that longevity is common to very many of the feathered

race, particularly to those of the larger kinds. One of the bones, a *tibia*,* measured two feet ten inches in length, and was proportionably thick. Two others measured, each, two feet six inches in length. Another, a section of a *femur*, measured eight inches in circumference in the smallest part. On putting together the bones of the leg and thigh (although none of them exactly fitted), and making the necessary allowance for the portions deficient of the processes of the joints, the intermediate cartilages, and lower tendons and integuments of the foot, we obtain, at least, six feet of the lower extremities of a bird; which, supposing its upper parts to accord in size with the lower ones, must have measured in altitude when alive, at the lowest rate of calculation, from fourteen to sixteen feet—an enormous feathered monster, well worthy, from its gigantic size, of being classed with the *Megalosaurus* of Buckland and the *Mastodon* of Cuvier.

It so happened that about this time a mechanic, who had been living at Cloudy Bay, in the Middle Island, came to reside at Poverty Bay. He stated that this bird now existed in the high hills near Cloudy Bay; and that two Americans, residents at that place, hearing from a native that such a bird lived on the mountainous and snowy heights, provided themselves with arms, and, thus equipped, went in high expectation of shooting one, taking the native with them as their guide. They ascended the mountain to the place where these birds resort, where, at the native's request, they hid themselves behind some bushes. Presently they saw the monster majestically stalking down in search of food; they were, however, so petrified with horror at the sight as to be utterly unable to fire on him. Had they commenced the combat, it is, I think, highly doubtful how it might have terminated. I think it very probable that they would have found themselves in a much worse situation than the Trojan chief and his followers did in their celebrated conflict with the harpies; so energetically and deploringly described by the poet in these lines:—

"Ergò, ubi delapsæ sonitum per curva dedêre
Littora; dat signum speculâ Misenus ab altâ
Ære cavo: invadunt socii, et nova prælia tentant,
Obscœnas pelagi ferro fædare volucres.
Sed neque vim plumis ullam, nec vulnera tergo
Accipiunt."†—ÆN. lib. iii., 238.

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* This has been sent by Mr. Williams, with several others, to Professor Buckland.

† For the benefit of the English reader, I give Dryden's translation of the passage from the celebrated Latin poet:—

"Then when along the crooked shore we hear
Their clatt'ring wings, and saw the foes appear,
Misenus sounds a charge: we take th' alarm,
And our strong hands with swords and bucklers arm.
In this new kind of combat, all employ
Their utmost force the monsters to destroy.—
In vain:—the fated skin is proof to wounds;
And from their plumes the shining sword rebounds."—Book iii., 311.

To return;—they observed him for near an hour, ere he retired, and were glad enough at last to make their escape from witnessing a meal, where, like him of old, instead of eating, they were all but eaten! They described this animal as being about fourteen or sixteen feet in height.

The bones from which the annexed drawings* [*Pl. IV.* and *V.*] were made, were all found at Turanga, Poverty Bay. They comprise a *tibia*, a *femur*, a *tarsus*, and a fragment of a *pelvis* and *dorsal vertebræ* of a *Moa*. They are very stout, are deeply marked with muscular impressions, and are in a good state of preservation. 1. The *tibia*, which is nearly perfect, measures thirty inches in length, and in girth, at the largest end (where it was much broken away at the edges of the processes, and consequently reduced in size), sixteen and a half inches; at the smallest end twelve and a half inches, and in the smallest part, near the middle of the bone, five and a quarter inches. There are not any remains of a fibula, however rudimentary, attached to the tibia, nor is there any apparent mark of attachment to indicate that such formerly adhered thereto. The largest tibia yet found, in nearly a perfect state, measured four inches more in length than this.† 2. The *femur*, which also is nearly perfect, measures in length thirteen inches; in girth, at the one end over the head of the femur, eleven and a quarter inches; at the thickest end twelve and a half inches; and in the smallest part five and a half inches: the reticulated muscular impressions on this bone are very numerous and well defined. I have seen a portion of a femur, the small part of which measured in girth eight inches. The one, however, from which the drawing was taken, though not so large, was more perfect; and it was in consequence of its being so that it was selected for the purpose. 3. The *tarsus* (a small one), nearly perfect, measures in length ten inches, and in girth at one end nine inches, and at the opposite end eight inches, and in the smallest part four inches; this bone is comparatively very short and flat, and has articulations for only three toes. 4. The portion of the *bone of the back and pelvis* is not so perfect, being a very much-broken fragment, comprising from the upper and outer edge of the *acetabulum* to the lower joint of the *dorsal vertebræ*, in which the canal for the *medulla spinalis* is perfect. This bone, or rather fragment, measures, from the outer edge of the articulation of the head of the *os femoris* to the outer broken edge of the bone (which is that portion approaching towards the upper part of the bone of the *pelvis*), eleven inches; and across the inner and smallest part of the bone, immediately beneath the

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* Drawings of these bones were sent to the Tasmanian Society, and published with the original monograph in their Journal.

† I much regret that I had not an opportunity of inspecting the largest and most perfect bones ere they were sent to England. A vessel sailing from Turanga for Port Nicholson, by which opportunity they were sent, was the reason of my not seeing them.

last of the *dorsal vertebræ*, where it was most perfect, seven inches. A correct idea cannot, however, be given of such a fragment as this, through the medium of a written description. This bone evidently differs very considerably from such bones in other birds, in its peculiar carinated shape in that portion of it which must have formed the highest part of the lumbar region; it must have been also considerably larger when entire, as the whole of the upper ridge is much broken. This bone is, also, very deeply indented with muscular impressions.

Having thus given, it is to be feared, rather a tedious detail of the *Moa*, and of the bones hitherto found, little remains at present than deferentially to offer a few remarks on the bones in question, and these suggestions may be noticed under two general heads: Firstly, does the *Moa* now exist, or, at what period of time is it probable that it existed? Secondly, to what order or family can we reasonably suppose the *Moa* to belong?

It is very true that at this time we have but little to assist us in our search; nevertheless, let us commence and prosecute our enquiry, considering such aids as may present themselves to our notice in the course of our investigation at all bearing on the subject before us.

Our first enquiry, then, will be, Does the *Moa* now exist, or, at what period of time is it probable that it did exist? To the first of these queries I reply, that it is my opinion that the species whose bones we have now before us does no longer exist, at least in New Zealand. A few reasons for this opinion of mine I will here adduce.

From my knowledge of the New Zealander, I can but believe that there is no part of his native land which has not been at one time or other trod by him, however mountainous or dreary it may be. As a proof of this, I might mention their having proper names for every portion of land and water, whether hill or dale, lake or running stream; and their never being at a loss in describing distant or unfrequented parts of their own country, some one or other present among the "listening crowd" having either visited the places spoken of, or received a narration from some one who had. Now, as no New Zealander is to be found who can positively state that he has actually seen such a bird, and as every nook and corner of the land is well known to the natives, I conclude that the animal in question no longer exists in New Zealand. In recording this opinion, it will be seen that I pay no attention whatever to the strange and fearful account of the *Moa* given by some natives, a relation which carries with it its own proof of being false; as I know full well the powers of the New Zealander for romance. The account, too, furnished to the Rev. W. Williams from the two American settlers, I also, in like manner, reject; but only as far as the bird whose bones we have before us is concerned. A very large and peculiar bird *may* exist

in the mountainous districts of the Middle Island; in fact, we know that several large birds, well known to the natives, though hitherto unknown to science, live on the high hills in the North Island. But I cannot persuade myself to receive one man's relation as perfectly correct in every particular, against the united testimony of those persons from among the different tribes of the Northern Island with whom I have conversed on the subject.*

In thus, however, disposing of that part of the question relative to the *present* existence of the *Moa*, we have still to enquire, at what period of time is it probable that this bird existed? And here, I think, we have to consider: first, the situation in which the bones are found; and, second, any additional evidence which native tradition may be able to afford us.

The *Moa* bones, as far as I have been able to ascertain, have hitherto been only found within the waters and channels of those rivers which disembogue into the Southern Ocean, between the East Cape and the South Head of Hawke's Bay, on the East Coast of the Northern Island of New Zealand. And, as I have before observed, they are only, when wanted, sought for after floods occasioned by heavy rains, when, on the subsiding of the waters, they are found deposited on the banks of gravel, etc., in the shallowest parts of the rivers. These rivers are, in several places, at a considerable depth below the present surface of the soil,† often possessing a great inclination, at once perceived by the rapidity of their waters. They all have more or less of a delta near their mouths, from a slight inspection of which it is known that their channels have, in those places at least, considerably changed. The rocks and strata in these localities indicate both secondary and tertiary formations; consisting, the former of argillaceous schist, sandstone, conglomerate, greensand, etc.; the latter of clay, marl, calcareous tufa, sand, gravel, and alluvial deposits. The real depositum, however, of the *Moa* bones is not certainly known. For my own part, I am inclined to believe, from a consideration of the depths of the channels of the rivers, and of the class and situation of the prevailing rocks and beds of strata in those parts, that they will be found lying embedded in the upper stratum of the secondary, or the lower strata of the tertiary formation; and not, I think, improbably in beds of shingle, the

* See Note D, Appendix I.

† The rivers at Waiapu and Turanga have high banks on either side, even where the country is a plain of rich alluvial deposit. Near Mangaruhe, and also near Whataroa (three days' journey inland from Poverty Bay), I descended the almost perpendicular banks of the river which falls into the Wairoa, where they were from thirty to sixty feet in height. This height they apparently preserved as far as the eye could trace them from the summits of the neighbouring hills. The Wairoa is a large river which disembogues into Hawke's Bay.

detritus of the deluge. In this opinion I, with some degree of diffidence, venture to differ from that of a respected and talented friend of mine, who supposes them to be of a much later period, and brought down from the mountains by the winter torrents; but, if they were thus conveyed from the mountains by the waters, the incessant rolling and friction to which they would have inevitably been exposed, would not only have broken off their finer parts, but would have also much battered and worn what remained. In all the specimens which I have yet seen, this, however, is not the case; for though broken and imperfect, they never appear to have been worn nor battered by friction, nor subject in any way to the action of water.

It has been alleged, that it is "in situations beyond the reach of river deposits that the fossil bones of ancient animals are usually found." Whilst, however, for the avoiding of unnecessary argument, I grant this as a general rule, I would remark, that I do not for a moment suppose that the bones of the *Moa* are deposited in the beds of those rivers in which they have hitherto been met with. No; they show by their appearance that their place of concealment is not in water; and they equally, I think, indicate that their deposition has been in places effectually excluded from light and air, a fact which is, in my opinion, incontestably proved by the natives never meeting with them but when washed up or appearing on the beds of gravel in the rivers. We should not forget that the immense *Megatherium* was originally discovered by M. Sellon on the banks of the Arapey; and the greater part of an entire skeleton of that animal (which was brought to England by Mr. Paris, the English Consul at Buenos Ayres), was found by a peasant, half covered with water, in the river Salado.

From native tradition we gain nothing to aid us in our enquiries after the probable age in which this animal lived; for although the New Zealander abounds in traditionary lore, both natural and supernatural, he appears to be totally ignorant of anything concerning the *Moa*, save the fabulous stories already referred to. If such an animal ever existed within the times of the present race of New Zealanders, surely, to a people possessing no quadruped,* and but very scantily supplied with both animal and vegetable food, the chase and capture of such a creature would not only be a grand achievement, but one also, from its importance, not likely ever to be forgotten; seeing, too, that many things of comparatively minor importance are by them handed down from father to son in continued succession, from the very night of history. Even fishes, birds, and plants (anciently sought after with avidity as articles of food, and now, if not altogether, very nearly

* The only quadrupeds indigenous to New Zealand are a dog, a small rat, a few *Saurians*, a bat, and, on the coast, one or two species of seal. [This note is a long one of nearly two pages in the original monograph, describing those animals. I omit it here. —W.C.]

extinct), although never having been seen by either the passing or the rising generation of aborigines, are, notwithstanding, both in habit and uses, well known to them from the descriptive accounts repeatedly rehearsed in their hearing by the old men of the villages, descendants of ancient days. This very silence, however, I embrace as a valuable auxiliary evidence, bearing me out not a little in my conjecture, that the bones of the *Moa* will probably be found lying either in the upper stratum of the secondary, or the lower strata of the tertiary formation. In fact, unless we suppose this immense bird to have existed at a period prior to the peopling of these islands by their present aboriginal inhabitants, how are we to account for its becoming extinct, and, like the *Dodo*, blotted out of the list of the feathered race? From the bones of about thirty birds found at Turanga in a very short time and with very little labour, we can but infer that it once lived in some considerable numbers; and, from the size of those bones, we conclude the animal to have been powerful as well as numerous. What enemies, then, had it to contend with in these islands—where, from its colossal size, it must have been paramount lord of the creation—that it should have ceased to be? Man, the *only* antagonist at all able to cope with it, we have already shown as being entirely ignorant of its habits, use, and manner of capture, as well as utterly unable to assign any reason why it should have thus perished.

The period of time, then, in which I venture to conceive it most probable the *Moa* existed, was certainly either antecedent to or contemporaneous with, the peopling of these islands by the present race of New Zealanders.

But we will proceed, and endeavour to ascertain (as we proposed in the second place to do) to what order or family it is likely that the *Moa* belongs? In making this enquiry, we have little to assist us but the bones before us; and these, from the writer's situation in this land, without any known osteologic specimens for comparison, or any scientific books for reference, and also from the bones being so few in variety, will, he fears, afford him but little help.

From an attentive consideration, however, of these bones, we are necessarily led to conclude that the animal must have been of large size and great strength; and from the shortness of the *tarsus* (when compared with the length of the *tibia*) we also perceive it to have been short-legged. From its size, we shall naturally be led to seek for its affinities among either the *Raptorial* or *Rasorial* Orders; but from its *tarsi* possessing only articulations for three toes, we are at once precluded from supposing that it belonged to the former order; to which we may also add, *first*, the negative evidence that not a single specimen or fragment of a wing-bone has yet been found; and, *second*, the judicious observation of Cuvier (in

reference to the family of *Struthionidæ*), that it would be morally impossible to fit such heavy bodies with wings sufficient to enable them to fly.* In the latter, however (the *Gallinaceous* or *Rasorial* Order), we have the largest and stoutest birds known. These, too, are terrestrial in their habits, some exclusively so, and very often possess only three toes. It is true that in general the different known members of the family containing the largest birds have their *tarsi* long (whereas those of the *Moa*, as we have already seen, are short). Yet to this we have exceptions in the extinct *Dodo* and the *Apteryx*; and I think it is highly worthy of notice, that the latter, the only known existing genus of the family possessing short *tarsi*, is entirely confined to these islands.

From a conviction, then, that it is in this order only that the affinities of the *Moa* are to be sought with any prospect of success, and that it is in the family *Struthionidæ* where they will doubtless eventually be found, we are induced, for the present at least, to place the *Moa* in that gigantic group. In the absence, however, of a specimen of an *Apteryx*,† with which to compare the few bones we at present possess of the *Moa*, I should, I confess, be hazarding an opinion in saying that it was most nearly allied to that peculiar genus; yet when we consider that out of the *five* existing genera of this family, three at least, apparently possessing the nearest affinities to the remains of the bird before us, belong exclusively to the southernmost parts of the southern hemisphere,‡ and that a connecting link is, as it were, wanting between the *Rhea* of the Straits of Magellan, the *Dromiceius* of New Holland, the *Casuarius* of the Indian Archipelago, and the *Apteryx* of New Zealand, and that this connecting link *may*, in all probability, be supplied in the *Moa*, I think we shall be constrained to assign our *Moa* a place between the genera *Casuarius* and *Apteryx*, possessing as it does (only in a much greater degree) the immense size and strength of the former, combined with the short *tarsi*, and probably wingless structure, of the latter.

I venture, however, to suppose, that we may gain an additional gleam of light, both upon the probable period at which the *Moa* existed, and also

* The Baron's words are:—"It appears as if all the muscular power which is at the command of nature would be insufficient to move such immense wings as would be required to support their massive bodies in the air." (*Règne Animal*, Class *Aves*, Ord. V., Fam. 1.) If such were the spontaneous remarks made by that illustrious naturalist, on contemplating the size of the known members of that family, what would he not have said had he but lived to examine the colossal structure of the *Moa*!

† It has been my good fortune to have at different times several specimens of the *Apteryx* in my possession; at present, however, I have not one, nor do I know in whose possession one is to be found in New Zealand.

‡ See Note E, Appendix I.

on the family to which it may be allied, by a consideration of the etymology of its name. The word *Moa*, whence is it derived? I confess, I know not any New Zealand word from which it may be supposed to have derived its origin. And this will seem the more remarkable when we consider that a very great number of New Zealand appellatives are not only derived and easily traceable, but are also generally highly expressive of some action or quality of the thing itself; chiefly, too, is this to be observed when such action or quality is peculiar or uncommon. But in the *Moa*, the most uncommon animal New Zealand has ever produced (especially in the estimation of a native), we have a cognomen which seems an entire exception to the common rule; for, as far as I understand it at present, it has, in reference to this immense animal, no meaning whatever. Further, it may not be amiss also to notice, *en passant*, that it is of rare occurrence in the language to find anything bearing so very *short* an appellation as the bird in question. In the Friendly, Society, and Sandwich groups, the term "*Moa*" has been, I believe, invariably given by the natives of those islands to the domestic cock, and used as the proper name for that animal by the missionaries there. The New Zealander, in relating his fabulous account of the *Moa*, almost invariably said it was like a "*tikaokao*," *i.e.*, a cock (they having given the cock that name from its crow, which to them sounded like those letters when drawn out and pronounced after their manner), and that it was adorned with wattles, etc. Without, at all, at present, entering into the question as to what country or countries the existing race of New Zealanders emigrated from to these islands, the popular belief that at least a portion of them is of Malay origin, is, I think, in connection with the name of this bird, worthy of notice; for whilst we know the term "*Moa*" is used to denote the cock in the Friendly Islands and other groups, it is only in the isles of the Indian Archipelago that the cassowary (*Casuarius casoar*, Briss.) is to be found; and this bird, too, is "heavy and stoutly built," and the only one of the whole family of *Struthionidæ* possessing wattles; for, according to Cuvier, it "has the skin of its head and top of the neck naked, of an azure-blue and fiery-red colour, with pendent caruncles like those of the turkey, and is the largest of all birds next to the ostrich."* May we not, I would ask, be allowed to conjecture, that in that now long-past period, when the forefathers of the present race of aborigines first landed on these shores, a few of those New Zealand birds might still be found in the most secluded and mountainous retreats, having hitherto escaped the repeated inroads of the original inhabitants; or, we may suppose that the bones only were seen, and identified to belong to a bird by those new-comers, to which, from their real or supposed resem-

* *Vide* Cuvier "*Règne Animal*," Class *Aves*, Gen. *Casuarius*.

blance to those of the cassowary, they gave the name of *Moa;* the name which that giant bird bore in their fathers' land ?

This conjecture, however, may be much more fully established, on ascertaining the name by which the cassowary is known to the present inhabitants of the islands of the Indian Sea.

The ornithology of New Zealand, now that these islands are become a British colony, will soon be known; and we may rest assured, that if such an animal exists, it cannot much longer remain concealed. And, it is further to be hoped, that ere long we shall be able to find somewhat more of the fossil remains of the *Moa*, so as not merely to form in part conjectural opinions on its size, habits, and affinities, but so as to be well-assured of what this prodigious creature really was.

APPENDIX, I.

Note A, page 64.

The *Tuatara* is an animal belonging to the Class *Reptilia*, Order *Sauria*; but to which of the families composing the same, I cannot, in the absence of books of reference, at present determine. It appears to possess characters common to *Lacertinidæ* and *Iguanidæ*, in its having the thin and extensible tongue of the former, combined with the undivided one of the latter. It is common in some parts of New Zealand, particularly on rocky headlands and islets lying off the coast. I have one at present in spirits, which I had alive for nearly three of the winter months; during which time, although I repeatedly tried to get it to take some kind of food, I could not succeed. From its habits I supposed it to be a hybernating animal. It measured nineteen inches in length, had a row of elevated spines (or rather recurved scales) nearly the whole length of its back, and appeared a perfectly harmless creature. It was taken, with two others, on Karewa islet, off Tauranga harbour, in the Bay of Plenty. The natives speak of another species, having a forked tail! and also assert that a larger species, which inhabits swampy places, has been seen six feet in length, and as thick as a man's thigh. The largest, however, that I have ever heard of did not measure above two feet in length.

Note B, page 65.

The shells of several species of *Haliotis*, *Ostrea*, and other nacrescent genera, are commonly used by the natives inhabiting the isles of the South Pacific for this purpose. A narrow slip of the shell is firmly fastened to the back of the hook, the barb of which is generally concealed by a tuft of metallic-surfaced blue feathers, procured either from the Korora (*Aptenodytes minor*) or the Kotaretare (*Dacelo leachii*). The hook thus prepared

and attached to a stout line, composed of the fibres of the Korari (*Phormium tenax*), which, after being cleaned from the parenchymatous parts, are twisted together by the hand, is drawn quickly through the water by a person paddling a small canoe; the larger fish, believing this glittering lure to be their prey, eagerly pursue it, and greedily catching at the same, are taken. In favourable weather a great number of fine fish are soon captured by this method. Among the New Zealanders it is a very favourite sport, and one that is not a little animating when several canoes are engaged. I have seen upwards of twenty small canoes thus employed on a fine summer's evening, on the beautiful sheet of water in the Bay of Islands. I may here mention that, previous to the introduction of the Gospel among the New Zealanders, their hooks were often composed of human bone; those of their enemies being used for that purpose. Sometimes they formed their hooks from the tough stalks and branches of Tauhinu (*Pomaderris ericifolia*) and Mangemange (*Lygodium volubile*), hardening them by the aid of fire. At present they invariably prefer the hooks which they make from iron nails to those of our manufacture, the latter, they allege, being much too brittle.

Note C, page 65.

Whoever has read the marvellous "Thousand-and-One Nights" must be well acquainted with the monstrous stories related of this extraordinary bird; its celebrity, however, is not confined to that work. "*Rukh*," says the author of the Arabic Dictionary, "is the name of a monstrous bird, which is said to have powers sufficient to carry off a live rhinoceros." To this animal Marco Polo also refers, in his relation of the story of the ambassadors:—"The *rukh* is said, by persons who have seen it, to measure sixteen paces across the wings from tip to tip, the feathers of which are eight paces in length, and thick in proportion. A feather of the *rukh* was brought by those messengers who were sent by the Grand Khan for the purpose of making enquiries respecting it, which feather is positively affirmed to have measured ninety spans, and the quill part to have been two palms in circumference." The existence of this immense bird seems to have obtained universal credence throughout all the Eastern nations; and while ancient historians make mention of certain enormous and peculiar animals as common to the Orientals, scientific men of modern times have wisely omitted such relations from their nomenclature.

Note D, page 72.

After all, it may very possibly be observed by some, that I act rather more precipitately than is consistent with judicious consideration in thus rejecting *in toto* the whole of such evidence. And such persons may also recollect the hastily formed conclusion originally arrived at by some of the

first Continental naturalists, in reference to the existence of the *Apteryx*, the Moa's probable congener :—" *L'Apteryx* de M. Temminck ne serait-il pas fondé sur les pièces de *Dronte* (*Dodo*) conservées au Muséum de Londres ?" —*Lesson*, *Manuel d'Ornith.* ii., p. 211. I do so, however, *on the spot*, after long investigation and careful consideration of the whole matter.

NOTE E, page 75.

It may not be amiss to give here an outline of the genera composing the Family of *Struthionidæ*, seeing they are but few. Each genus contains but a single species. In the present state of our knowledge the group may be thus arranged :—

Class AVES.

Order IV. RASORES, *Vigors.*

Family 4. *Struthionidæ.*

1. Genus *Struthio*, Linn. (Type of the group.) *Ostrich* of South Africa: possessing two toes.
2. Genus *Casuarius*, Brisson. *Cassowary* of the Indian Archipelago : three toes.
3. Genus *Dromiceius*, Vieillot. *Emu* of New South Wales : three toes.
4. Genus *Rhea*, Vieill. *Nandu* of Straits of Magellan : three toes.
5. Genus *Didus*, Linn. *Dodo*, formerly an inhabitant of the Isles of Mauritius and Bourbon : three toes : extinct.
6. Genus *Apteryx*, Shaw. *Kiwi* of New Zealand : three toes and a rudimentary one.
7. ———? ——? *Moa* of New Zealand : three toes : supposed to be extinct.

EXPLANATION OF PLATES IV. AND V.

PLATE IV.

FIG. 1. *Tibia* of *Moa*, nearly perfect, 30 inches in length.

a, *a*, girth 16½ inches, bone at the end much broken and reduced in size.

b, *b*, girth, over processes, 12½ inches.

c, *c*, girth, 5¼ inches ; smallest part.

d, deep muscular impressions.

e, *e*, girth, 9 inches.

Note.—The largest *Tibia* yet found measured 4 inches longer than this.

FIG. 2. *Femur* of *Moa*, nearly perfect, length 13 inches.

f, *f*, girth, 12½ inches.

g, *g*, reticulated muscular impressions, very numerous.

i, *i*, girth, 7¾ inches.

k, *k*, girth, smallest part, 3½ inches.

m, *m*, girth, 11¼ inches.

Obs.—I have seen a portion of a *femur*, the *small* part of which measured 8 in. in girth ! The one from which the drawing was taken, though not so large, was more perfect.

FIG. 3. *Tarsus* of *Moa*, nearly perfect, length 10 inches.
p, *p*, girth, 9 inches.
r, *r*, girth, 4 inches.
s, *s*, girth, 8 inches.

PLATE V.

FIG. 1. Upper surface of fragment of *pelvis* and *dorsal vertebræ* of *Moa;* deeply indented with muscular impressions.
a—b, measures 9½ inches.
c, canal of *medulla spinalis.*
d, outer edge of *acetabulum.*
Obs.—This bone differs very considerably from such bones in other birds, in its peculiar carinated shape in that portion which must have formed the lower part of the back. It must have been also considerably larger when entire, as the whole of the upper ridge is much broken.

FIG. 2. Under surface of Figure 1.
a, *a*, a perfect part of the bone, where, in the narrowest place, it measures 3 inches half-way across.
b, outer edge of *acetabulum.*
c, canal of *medulla spinalis.*

PART II.—*What I have gleaned since.*

§ 1. POSITIVE (if such it may be called)!

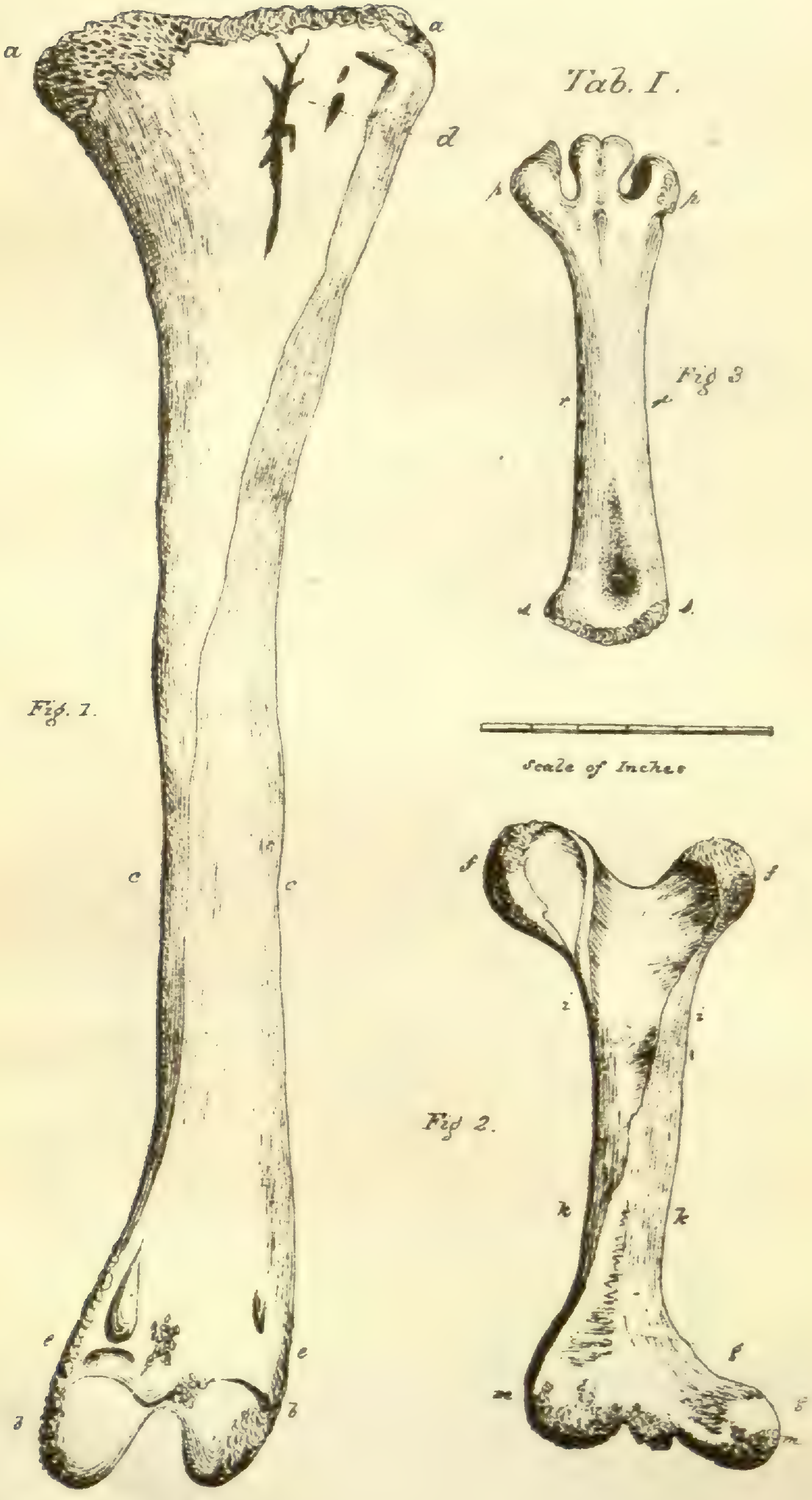
I. MYTHS, OR LEGENDS.

1. *The Myth of Ngahue.*

IN all the legends and myths of the Maoris that I have heard recited, and taken down, and received from them in writing (including, also, those published by Sir G. Grey*), I have only once met with any mention of the Moa; and this is in the very ancient Mythe of Ngahue;† who, it is said, visited New Zealand *before* the so-called migration hither from "Hawaiki:" therefore it is that I place this legend first in order. In this legend, which is a particularly interesting one, the Moa is mentioned twice; but then only in the most casual way—provokingly so! I shall just give here the *two* short sentences from that original Maori tale; as I intend translating the whole of this brief legend with explanatory notes shortly. Strangely enough, the translation of this tale given by Sir G. Grey (*supra*) omits one of those two sentences which mention the Moa, or I would willingly quote from his published translation.

Of Ngahue it is said,—that he arrived in New Zealand and visited both Islands; and on his returning from the South, Arahura (= Westland), and on his way to the East Coast, Whangaparaoa (= Cape Runaway), "he

* "Polynesian Mythology," 1855.
† Called in the Polynesian Mythology (p. 132), "The Legend of Poutini and Whaiapu."



Drawn from Originals by W.C.

Tab. II

Scale of Inches.

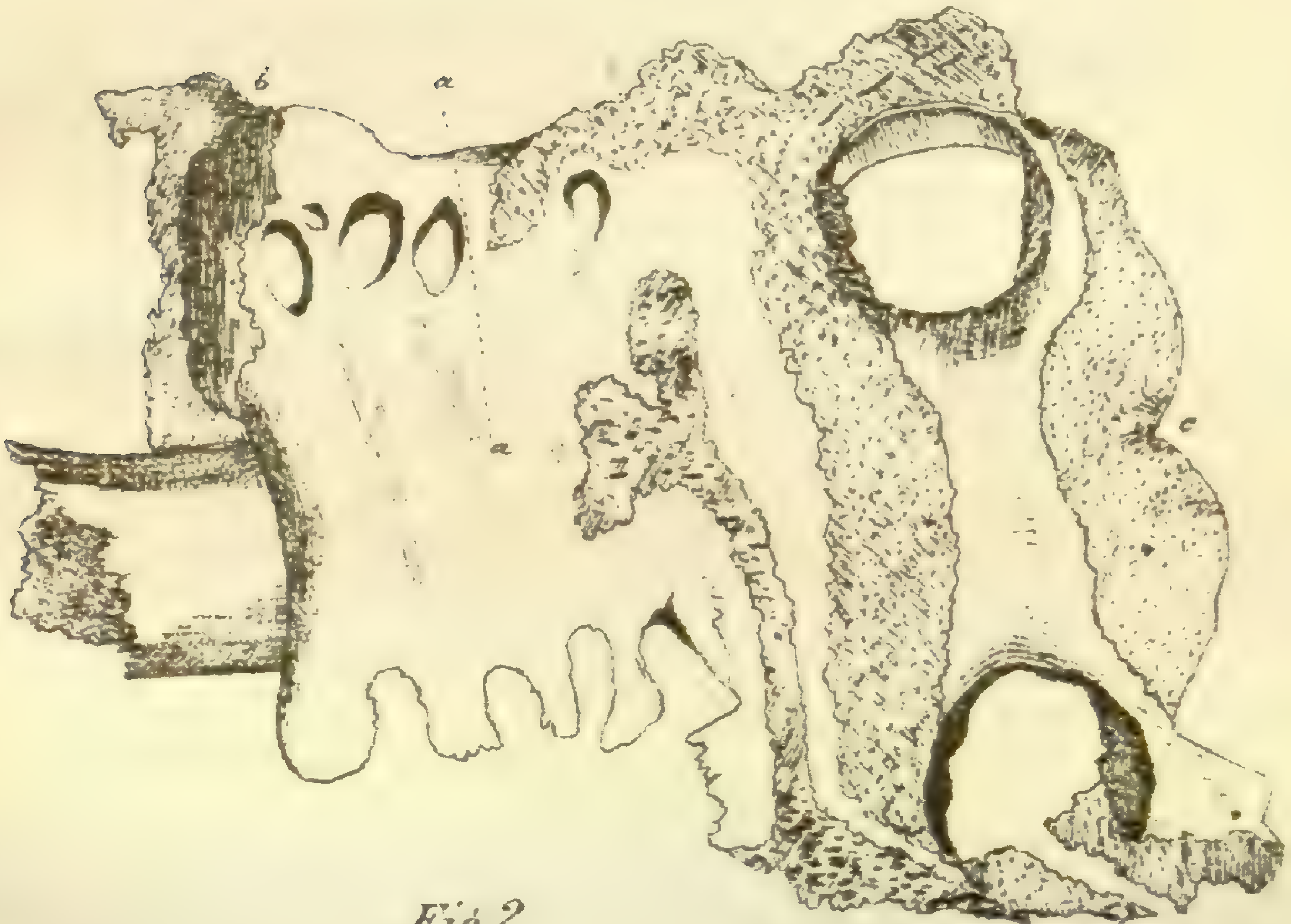


Fig. 2.

Drawn from Originals by W.C.

killed the Moa at Te Wairere."* On his return to Hawaiki he related that "he had seen the land containing the green jade stone and the Moa."

2. *The Legend of the Destruction of the Moas by Fire, etc.*

A few years ago, while engaged in prosecuting my Maori etymological enquiries for the New Zealand Lexicon, I received the following from an old intelligent chief of the East Coast respecting the Moa :—

"Anciently the land was burnt up by the fire of Tamatea; then it was that the big living things, together with the Moas, were all burnt. Two Moas, however, survived with difficulty that destruction—but only two; one of these lived at Te Whaiiti, and one at Whakapunake.† The feather of this one at Whakapunake has been seen and found; it was preserved as a plume decoration for the heads of dead chiefs of note, when their bodies were laid out on a sumptuous bier for the funeral obsequies. The name given to that feather was *ko-te-rau-o-piopio* (= the special plume of Piopio). The forefathers of the Maoris heard of the Moa, but they never saw its body, only its bones."

Falling-in lately with an old chief of the Ngatiporou tribe, from Tokomaru, near the East Cape, and enquiring of him, if he knew anything of the Moa? He replied, "No; all that was known by them was the old tradition from their forefathers, that the Moas all perished through the fire of Tamatea, save one which escaped to the mountain Whakapunake; where it was said to sit in its cave with its mouth open, and hence to live on air."

Here I would observe, that Tamatea is a very ancient name in the New Zealand mythological history, and is frequently mentioned both in their proverbs and songs. It occurs, also, several times with varying suffixes full of meaning in their old astronomical lore (of which more anon). Tamatea is said to be one of the sons (or grandson) of Tato, who, according to some genealogies, was the fifth lineal descendant from the first man Rangi = the sky; their names are thus given together in one of their old genealogies :—"Now I will begin to rehearse the coming hither of Tamatea, his fathers, and elders; these are the names of his children, Rongokako, etc.; these are all the children of Tato."‡ And these are also said to have come hither in the *waka* ("canoe") Takitimu. While another genealogy (that of the Hawke's Bay tribe—Ngatikahungunu), commencing also with Tato,

* Probably the cliff and waterfall of that name near the river Waihou, between Tauranga and Matamata.

† Vide Part I., pp. 64-68.

‡ I give also the Maori of this, on account of some of the names :—"Ka timata tenei i te haerenga mai o Tamatea ratau ko ona matua; ko nga ingoa enei o ana tamariki,—ko Rongokako, ko Hikutapuae, ko Hikitaketake, ko Rongoiamoa, ko Taihopi, ko Taihapoa, ko Kahutuá, ko Motoro, ko Te Angi, ko Kupe, ko Ngake, ko Paikea, ko Uenuku, —ko nga tamariki enei a Tato."

gives his son as Rongokako, whose son was Tamatea, whose son was Kahungunu, and from this man (the founder of their tribe) down to the present generation are just twenty-one generations. In another old story we have the following :—" When Tamatea arrived, he burnt up the tangled mass of herbage and scrub from the surface, then it was that man, possessing useful land, dwelt and lived well."

3. *Of the " Feathers," etc., of the Moa.*

On my reading the first part of my paper on the Moa,* a discussion ensued ; when Mr. Locke, who was present, said that he had formerly heard when travelling in the interior among the Urewera tribe, a very similar relation from them in reply to his enquiries respecting the Moa ; and that he had also heard more than once from the old chiefs on the East Coast, south of Hawke's Bay, that they had themselves seen the feathers of the Moa, which were anciently used for head decoration. As this, about the feathers and their use, was new to me (as coming from these persons), I lost no time in making further enquiries in that direction, and the following (extracted from several letters) is the result :—

1. *(May 7, 1879.)* " This is a return to your questions concerning the Moa. I have made diligent enquiry of the chief Hawea and others. At that very time, too (when the letter arrived), the chief James Waiparera was here staying ; he had come from his place at Patangata to conduct hither certain visitors from Rotorua and from Tauranga. They all heard me read to the chief Hawea your long letter of enquiries, even unto the end of it. Then they said, to take up each question separately ; and this was also done. Then they all, including Hawea, said to me : Write to him (Colenso), and say, No man of old ever saw the Moa ; the last of men, perhaps, who ever saw the Moa, was in the time of Noah ;† because it was at the time of the overturning in the days of (or by) Mataoho‡ that the race of Moas died, whose bones are now seen. The men of the after times did not (see it) ; the men also who preceded Wahotapaturangi§ did not see it, down to the times of Te Heheu ; and now here also am I, an old man, relating this. All those men never saw the Moa, also myself I never saw it.

* Trans. N. Z. Inst., Vol. XI., p. 568.

† This, of course, is from Genesis, and refers to the Deluge.

‡ Thus referred to in the very old legend of Tawhaki :—" Tawhaki, having recovered from his wounds, left that place, and went and built a fort on the top of the mountain for himself and tribe, where they dwelt. Then it came to pass that the rain was let down from the sky, and the land was overwhelmed, and all men died ; from which circumstance (that flood) was named—' The overturning of Mataoho ;' and so they perished." (See this amplified in " Polynesian Mythology," p. 61.)

§ This was Hawea's grandfather, who, with his son Te Heheu, saw Cook. Te Heheu died about thirty years ago, old and full of days.

I cannot possibly tell a lie in this matter to thee (emphatic), and say, I saw, or I heard of it. Those men of olden time, as I have said, never saw* the Moa—that is, its body, its size, its length, its height, its feathers—never once. No man ever heard of the taste of its flesh, and of its appearance; or of its fat, or its skin, or its being sweet or bitter to the taste.† For if, indeed, those men of old had known anything of the Moa, they would have left that knowledge to be talked of and handed down to the men of after times. But inasmuch as those men of the olden time did not know, therefore it is most certain that these men who came after them did not know also. Again: you enquire, 'How is it that the Maoris of to-day know these bones which they see to be of the Moa?' According to my way of thinking, our old ancestors saw those said bones and called them so, and thus it is that we now know them to be such. But no man of old knew anything more of them, so that they knew it (as) food, or the real living appearance of its bones (when clothed with flesh), which are now seen by us bigger than those of a horse! Hawea also says, No man of old before the time of Wahotapaturangi knew anything of the food of the Moa, or of its habitat. This phrase, 'the air-eating Moa '(=*te Moa kaihau*), is only a common proverbial saying among us; it is often applied to a man; a man-moa is such-a-one who turns away from his food and lives on air. Again, with reference to the feathers of the Moa, it is said that the feather called the plume of Piopio *(Te rau-o-piopio)* is from the Moa. When the chiefs of the Maoris die, then this feather is stuck in their hair, and the body so decorated is placed on the raised platform (prepared for it), and the friends and visitors, on seeing it, exclaim, 'Thou art good (or beautiful), O plume of Piopio!' Here ends what was said by Hawea and his friends, visitors, about the Moa."

2. *(July 4, 1879.)* "Referring to your further enquiries about the feather of the Moa, called the plume of Piopio, Hawea says,—there is no known body whence came this feather; the body in which it had been fixed was that of the Moa at the mountain Whakapunake; it was a feather from it. It was blown hitherwards by the winds, and, on its being seen, drifting, it was picked up. When a chief died, that feather was taken and used for head decoration while lying on the ornamented stage, or bier; and when the corpse was finally borne away, that feather was taken out of the hair and preserved for some other chief who should afterwards die. Hawea also says that the look of this feather was just like that of the Peacock, that it did not differ a bit in its glossiness and variety of colours, in its

* I believe the true meaning of the verb *(kite)*, here, is—heard of, *i.e.*, knew from relation; heard it clearly described.

† All this is with especial reference to my many separate enquiries.

length, and in its ocellated appearance; its great beauty altogether was exactly that of the feather of the Peacock."

3. *(July 18, 1879.)* "This is in answer to your new and repeated questions to Hawea concerning the said feather called *Te rau-o-piopio* (=the plume of Piopio) and *Te Kowhakaroro*; this is what he says:—I will first speak of the body whence came that feather. I have heard formerly the old men talking and saying that the Moa fed on air (or wind); that it never walked about, but kept its head always turning. The Moa race was killed through the overturning of the Earth by (or in the time of) Mataoho; therefore it is that only the bones are now found. Another saying of theirs, that one Moa only escaped from that destruction, and this one dwells within the cave at the mountain Whakapunake; but this (saying) perhaps is false, and this is my reason for saying so:—In my time (early days) a travelling party went thither, and I saw how they were teased about it on their return. A feather, however, was found stuck fast on a white pine tree *(Kahika)*, which was brought back. When Matawhaiti died, (the ancestor of Tukuwaru,*) this said feather was stuck in his hair, and it was afterwards reserved for that purpose of decorating the heads of deceased chiefs when laid in state upon the bier. I, myself, saw that feather on that occasion; and so did (many of) the men of Te Wairoa and of Te Whakakii (in Hawke's Bay), they also saw it. That one feather bore two names—*Te rau-o-piopio*, and *Te Kowhakaroro*. It was like the feather of the Peacock, that is in its ocellated appearance; very likely if that bird, the Peacock, had been a native of this island, then that feather would be certainly said to be a Peacock's feather. All those are Hawea's words."

4. *(July 21, 1879.)* "Shortly after my last letter to you was written, a visiting party arrived here from the neighbourhood of the mountain Whakapunake, and we again talked about the Moa, on account of your enquiries. Those men say, in addition to what I have already informed you,—that the famed Moa of Whakapunake bore twelve of those beautiful round-eyed feathers, resembling those of the Peacock. From (signed) Hawea."†

II. Proverbs.

1. *He koromiko te wahie i taona ai te Moa.*

The firewood with which the Moa was baked was of Koromiko *(Veronica salicifolia)*.

* An aged chief still living here in Hawke's Bay.

† I have been careful to be exact in making those translations of, and extracts from, Hawea's letters to me, even to the repeating of some portions, as I wished to give them as I received them;—it may be for future reference. I had purposed the giving them also in their original Maori, in the Appendix to this paper. Hawea, being aged, very rarely writes himself, but employs constantly a middle-aged Maori, named Hamuera, to write for him; who, I know, is to be relied on for accuracy: hence it is that Hawea is generally spoken of in the third person.

This is often said on seeing the hissing sap-like exudation issuing from the branches of the Koromiko shrub when fired, green or wet; which sap is also said to be the fat, or oil, of the Moa.

Note, here, the *mode* of cooking, as shown by the verb (*tao*), is that of the earth-oven or *haangi*; but the koromiko shrub is never used for such a purpose, the wood being much too small.

[I may here mention that the late Sir Donald McLean, who had kindly endeavoured in former years to glean some information for me relative to the Moa, in his travelling in his official capacity and meeting with the old Maori chiefs, told me that this common saying was all he had met with.]

But then a similar proverb, or saying, is also used concerning this very same shrub when burnt green, connecting it with Tutunui, the pet whale of Tinirau (which whale was killed and roasted and eaten by Kaé, as fully related in their myths);* namely—"*Tena te kakara o Tutunui!* = Excellent is the nice smell of (the whale) Tutunui (roasting)!

2. *He mihiau te kowhatu i taona ai te Moa.*

Mihiau was the (kind of) stone with which the Moa was cooked, or baked.

This apparently simple saying has given me a world of trouble. During several years I have been enquiring the kind of stone called *mihiau*, but with little or no success. One intelligent old chief only, seemed to know something about it; according to his statement, a *mihiau* was one of three sorts of stone anciently used for cutting and lacerating their flesh in times of grief, and death of relatives—*waiapu*, *paretao*, and *mihiau*—and all three were, I think, of a volcanic nature (*Waiapu-obsidian*), and therefore could not be used for common baking purposes; besides, their own highly superstitious fears as to any desecration of the *tapu* would have prevented their so using them. Has this any hidden, or obsolete, reference to the "fire of Tamatea" (*supra*)? which is said to have originated from the country near the burning mountain Tongariro.

Further, the name itself is a strange one. Etymologically it means—thy expressed grief after something dead, or gone; *mihi* = grief, or affection shown after something absent;† *au* = thy, or thine; and as such the name would be a highly poetical one for a cutting bit of sharp stone used only for lacerating purposes on account of the departed.

3. *Ko te huna i te Moa!*

All have been destroyed as completely as the Moa!

Said of a tribe—of a fighting party—of the people of a village—or of a family, when *all* have been surprised and killed—or carried off by death.

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* *Vide* "Polynesian Mythology," p. 92.

† See Tangaroa-mihi, "Trans. N. Z. Inst.," Vol. XI., p. 100.

4. *Kua ngaro i te ngaro o te Moa!*

All have wholly disappeared, perished, just as the Moas perished; none left! (A saying similar to the foregoing, and used under similar circumstances).

5. *Na te Moa i takahi te raataa.*

The Raataa tree (*Metrosideros robusta*) was trampled down, when young, by the Moa—hence its irregular growth. (The meaning being, early evil habits are not to be afterwards overcome. "Just as the twig is bent, the tree's inclined.")

6. *Ko te Moa kai hau!*

Even as the Moa feeding on air!

This saying, which is also very ancient, arose from the belief of the myth that the Moa (the one that had escaped from the universal fiery destruction) resided in a cave on the top of the mountain Whakapunake, with its mouth wide open; hence it is said to feed on the wind, or air.

7. *He Moa oti koe, ina ka kore koe e kai?*

Art thou, indeed, a Moa, that thou dost not eat?

8. *He Moa kai hau!*

A Moa living on air!

9. *He puku Moa!*

A Moa's stomach, or appetite!

Those last four proverbial sayings, nearly alike in meaning, are used—(1) in banter of a man in health who has no appetite for food; and (2) of a woman who at meal times cares not to eat, through being very deeply in love—her lover being absent, or his person not agreeable to her tribe and family, and so her affections are crossed, etc., etc.

Of this latter we have a notable instance in Hinemoa, the woman whose name is handed down in a tradition of the olden time, as having swum in the night from the mainland at Rotorua to Mokoia, the island in the large lake there, to meet her lover, Tutanekai, the object of her desire. Hence, too, as her people suspected her, seeing she did not care to eat, etc., she got the provisional name of *Hinemoa*, which subsequently stuck to her; like many other names of very frequent occurrence among the Maoris, through derision, accident, fault, war, etc. *Hine*=young lady, daughter of rank; and *Moa*=the mythical animal—*i.e.*, the young lady who left her food, or lived on air (just as the Moa), on account of her love for her sweetheart. Her name has been given to the Colonial Government steamer 'Hinemoa.'

There is still, however, another meaning belonging to the words "*He kai hau*;" namely, that it is the name of an ancient malediction or curse used by sorcerers; in which death is invoked on him who makes a practice of receiving gifts without giving any in return, so that he pines away and dies. This, in connection with the mythical creature the Moa, might some-

times also have had something to do, among such a dreadfully superstitious race, with sudden and unaccountable loss of appettite. This remark, however, can only be fully appreciated and considered by those who well knew the ancient Maoris in their old times of superstitious fear and dread; when everything which happened and could not be satisfactorily accounted for, was immediately placed to the malevolence of some fancied supernatural demon *(atua)*, or human sorcerer *(kai-makutu)*.

III. POETRY.

1. In a long and ancient poem, or chaunt, called "the Lament of Turaukawa"—in the midst of many similar references to the oldest Myths and Legends—occur these lines :—

—— "Kua rongo 'no au
Na Hikuao te Korohiko,
Ko te rakau i tunua ai te Moa
'A rewa aana hinu."*——
I have indeed heard (from olden times),
That the Korohiko† (shrub) was by Hikuao
The very tree with which the Moa was roasted
When all its fat was melted down.

2. A lament, or dirge, over the slain, concludes with these words :—

"Mowairokiroki, ko te huna i te Moa,
I makere iho ai te tara o te marama."‡
Very calm and placid now the raging billows have become,
Even as (it were) at the total destruction of the Moas,
When the cusps of the new moon dropped off and fell down (to earth).

3. In another song is a very peculiar reference to the Moa, such as I have never heard of or met with anywhere else, except in Hawea's relation respecting the use of that one feather *(ante)*. The song itself being very short, just one stanza, I shall give it in its entirety with an almost literal translation :—

"E! muri koe ahiahi ra,
Tango mai te korero, o namata,
O nahe rawa, o nga kahika;
E, kei runga riro,
Kei a Kahungunu;
Ko te manu hou nei e, te Moa,
Hei tia iho mo taku rangi."§
Alas! afterwards do thou in the evening hours
Produce and begin the talk of old,
The story of the very earliest times
Of the great ancient men;
Thus let it be, begin with the very beginning of all,

* Sir G. Grey's "Poetry of the New Zealanders," p. 324.

† Korohiko is another name for Koromiko = *Veronica*, sp.

‡ "Poetry of the New Zealanders," p. 180. § "Poetry of the New Zealanders," p. 133.

With the chief Kahungunu;
So that the bird's plume here present,
That is to say of the Moa
Shall be stuck into the hair of my principal chief (or beloved one).

Meaning, the principal one spoken of, or being now bewailed.

I should say (1) that this song is not a very ancient one; (2) that it must have been sung by some of the Maoris of the East Coast, descendants of Kahungunu; (3) that Hawea's statement throws great light on it; (4) that such a song would be highly suitable, and wholly in keeping with what would be sure to take place, as preliminaries, on the assembling together at the death of a chief,—say, the first day or evening of meeting; (5) that on such occasions the assemblage would begin with their tribal progenitor (Kahungunu) and come down *gradatim* to the one lately deceased (lying before them), who would thus have *the last* word; (6) that it is more particularly applicable (from the last two words) as a lament over a *young* person of high rank.

4. Another song from the East Coast concludes with this stanza:—

"Tu tonu Puhirake, ko te Moa kai hau,
He whakareinga rimu ki o pou, raia."*

Which, as the song is a peculiarly taunting one, may be thus translated:—Poor betrothed beauty, there thou art alone and forlorn, standing continually in the midst of the dense thicket, even as the Moa feeding on air, thy posts (supports or fences) are only for the long, shaggy, ash-coloured, lichen to fly and adhere to, nothing more!

To the Maori those two lines possess a whole multitude of suitable images and ideas.

5. In an ancient dirge-like song, or chaunt,† of great poetical depth and beauty, and very carefully composed,—often used in times of heavy disaster and death, the old and common proverbial saying already noticed,‡ ("*Kua ngaro i te ngaro o te Moa!*"), is brought in with thrilling effect at the end of the third stanza.

Here I may mention that, in 1852, at a season of extraordinary calamity here in Hawke's Bay, I both re-wrote (*a-la-Maori*) with variations, and translated into English, this composition; and on my reciting it, in Maori, before several chiefs who were assembled here from several places in the southern portion of this North Island (one of whom was the late Karaitiana), I was not a little surprised to find they could all join in many of its parts, including the ending of all its stanzas. I then discovered that it had long been a truly national poem (so to speak), and, like very many others

* "Poetry of the New Zealanders," p. 96. † "Poetry of the New Zealanders," p. 9.
‡ *Vide* "Proverbs" (*ante*), p. 86.

of their poetical effusions, altered from time to time to suit the *present* occasion.*

I have carefully gone through more than 900 pieces of Maori poetry, including Sir G. Grey's published collection, some of them very long (and not a few of them written coarsely in a wretched hand); indeed, I may say I have laboriously studied them all in the course of many years, and these few lines which I have here brought before you are all that I have been able to discover in them relating to the *Moa*—just those *five* small scant and antiquated sentences! There are, however, a few others containing the bare word "Moa," but those are merely references to names of persons, or poetical contractions of other common words having in them those three letters, and possessing little or no bearing on the subject before us.

IV. Names of Places and of Men of the Olden Time which contain the Word "Moa."

Of such I have obtained several; but—as I cannot, in a single instance, be sure of the word or term in question strictly belonging to the extinct animal or bird *Moa*—I shall defer the consideration of this part of my subject to the second (or negative) head of this enquiry.

§ 2. Negative.

1. In all the many legends and myths of the Maori, some of which are of great antiquity—from *before* the time of their common genealogical period or beginning, commonly known as "Hawaiki," or "no Hawaiki"—there is no mention of, nor reference to, the *Moa*, save that one solitary and brief intimation I have already quoted.† And yet there were plenty of opportunities in them of bringing the living Moa prominently forward, if that animal were then known, or, at all events, of some casual allusion to it, or to their manner of capturing and killing it. As, for instance (among many others), in their several fables of birds, in which the birds converse one with another, etc., as may be seen in the Fable of the Great Battle of the Land and Sea Birds;‡ in that of the *Hokioi* (another large and extinct bird), and the *Kaahu* (hawk); in the myths of the slaying of those several Saurian monsters;§ and in the old legends of Maui, and of Hatupatu and his brothers, in which the various birds are made to play such an important part;—those ancient stories are all silent concerning the Moa. So, again, where in them special mention is made of the food, particularly birds, to be found in plenty in certain regions; such as was said of the chief Takakopiri, in the legend of Kahureremoa—that "he was a great chief, and had abundance of food of the best kinds on his estates; plenty of potted birds of all kinds (pigeons, and *tuis*), and *kiwis*, and *kiores*, and *wekas*, and eels;" and

* *Vide* "Essay on the Maori Races:" Trans. N. Z. Inst., Vol. I., p. 47, *Essay.*

† *Vide* p. 80, Legend of Ngahue.

‡ See Trans. N. Z. Inst., Vol. XI., p. 101. § See Trans. N. Z. Inst., Vol. XI., p. 87, etc.

again it is said, the question was asked, "What is the name of yonder mountain? and they answered, That is Otawa. And the young girl asked again, Is the country of that mountain rich in food? and they replied, Oh, there are found *kiores*, and *kiwis*, and *wekas*, and pigeons, and *tuis*; why, that mountain is famed for the variety and number of birds that inhabit it."*

2. Further: with reference to the very great use of feathers as ornaments for the hair, which were greatly prized by the chiefs of olden days, there is also no mention, no allusion, however distant, to any feathers of the Moa in any of their legends; although there are plenty to the feathers of other birds, sea and land,—both as head decorations and as forming cloaks, for which latter purpose those of the *Kiwi* were commonly used. And from the now known fact, of the *Moa* being also a struthious bird and a congener of the *Kiwi*, and its common body feathers equally as well if not better adapted, being stronger and tougher, for the feather-cloaks of the ancient Maoris. How are those omissions to be accounted for if the *Moa* were known? Especially if (as Hawea says) that one feather he had seen was so surpassingly handsome! In the old Legend of Marutuahu we read of the killing of birds for food in the interior, and of the young chief, who had been out hunting and spearing birds, dressing himself finely in his cloaks and feathers, when, "after combing his hair he tied it up in a knot, and stuck fifty red *Kaaka* (= Parrot) feathers in his head, and amongst them he placed the plume of a white heron, and the tail of a *huia* as ornaments; he thus looked extremely handsome, and said to his slave, Now let us go: for he now appeared as handsome as the large-crested cormorant."†

3. Their proverbs, too,—many of which are very old—contain no other allusion to the *Moa* than those few very meagre and misty mythical ones I have already quoted; and yet they deal largely with all Nature, animate and inanimate, known to the New Zealander; the various animals, particularly birds, coming in for a full share of notice; of those drawn from birds alone—their natural habits, powers, feathers, appearance, uses, etc., I have collected nearly 70. Here, too, we find proverbs in plenty relating to food and delicacies,—especially to what, being wild, was obtained by hunting and snaring:—*e.g.*—

"*Haere i muri i te tuara o Te Whapuku,*
Kia kai ai koe i te kai whakairo o te rangi."

* "Polynesian Mythology," pp. 262, 264.

† "Polynesian Mythology," p. 250. And, also, that Cook, with his band of scientific men with him, while they often speak of the quantity and variety of feathers with which the New Zealanders ornamented their hair, mention them as belonging to New Zealand birds they had seen or secured: and those chiefs dressed themselves in their very best finery.

—When you travel, join yourself to the company of the great chief Te Whapuku, that you may eat of all the choicest delicacies (particularly game and wild fowl) ;—which delicates are stated to be (by an old Maori chief commenting thirty years ago on this very saying) " birds" (pigeons and tuis) " potted in their own fat in calabashes, parrots, and ground-parrots (*kaakaapoo*), rats, and eels, and berries of the *tawa* and *hinau* trees."—Another pregnant omission!

4. If their old proverbs contained little allusion to the *Moa*, their old poetry contained still less (as far as is known to me.) And here I may also briefly mention two peculiar quaint poetical ditties of the old Maoris, both being long laments after nice and plentiful food formerly known and eaten; in which every chief article of pleasant food is severally noticed, together with its habitat. The one being a kind of nursery-song, chaunted to a child while nursing it; the other the lament of the chief Kahungunu (who lived twenty-one generations back), when away in the cold Patea country in the interior; in both of which, while mention is made of many birds, no allusion whatever is made to the big fleshy food-yielding *Moa!*

5. Moreover, while the ancient Maori possessed charms and spells, and prayers for luck in plenty for everything they did, particularly for fishing and fowling and the snaring of rats; and such, too, varied for every different animal whether of the land or of the sea; how is it that there is none for the *Moa*? which must by far have been the most difficult to catch or kill; or, at all events, by far the biggest game of all! Here we have, still extant, those charms and spells for being successful in taking the various birds—*kiwi* (Apteryx), *kaakaapoo* (ground-parrot), *koitareke* (quail), *weka* (wood-hen), *kaakaa* (brown parrot), *kautuku* (white heron), *huia* (Heteralocha), *kereru* (pigeon), *tuii* (parson-bird), *pukeko* (swamp-hen), *parera* (duck), *whio* (blue mountain-duck), *kawau* (shag), and *toroa* (albatross)——besides the various petrels (?) *taiko*, *toanui*, *tiitii*, and *oi;* some of those charms being also of great antiquity, and yet there is none for capturing the *Moa!* This alone has ever been to me an unanswerable argument.

6. In travelling in the interior of this North Island—largely I may say—more than forty years back, I have often had pointed out to me the old land-marks of the game preserves of the ancient Maori, particularly of the ground game—as quail, *kiwi*, *kaakaapoo* (ground-parrot), and *weka;* and the mountain-passes where, in the breeding-season, the *tiitii* (petrel) was taken in a foggy night by firelight; and also the cliffs on rivers which were smoked and scaled for the fat young of the *kawau* (shag) ere they were able to fly; even then, at that time, some of those birds had become extinct (as, notably, the quail and ground-parrot), the young men had never seen them, but the old ones had, and caught and eaten them too, in great plenty; and

while they all knew them well by description and oft-told tale, there was nothing whatever known or rehearsed of the habitats of the colossal *Moa*, save the mythical dwelling of the only one on the top of the high mountain Whakapunake!

7. Further still, I think some notice, however slight, should be taken of the great predilection of the ancient Maori towards making pets of wild animals, even including those of the most extraordinary and bizarre kinds, as we may see in their ancient legends of "Kae and the Pet Whale of Tinirau,* and of "The Killing of Kataore," the monstrous Saurian pet of the chief Tangaroamihi.† Those stories, however, are both very old and almost prehistorical. Then we have the account of the tame lizard pet of the chief Kahungunu, named Pohokura, which was carried by him from Taputeranga, in Hawke's Bay, to Te Awarua, on the western flank of the Ruahine mountain-range, near the head of the Rangitikei river (about twenty-one generations back), and got loose there, and was not recovered. This lizard pet is still believed by the old Maoris to be dwelling in those lonely mountain forests! Captain Cook and other early visitors tell us how very much the New Zealanders were addicted to pet animals; and, in my own time, I have known of their pet indigenous birds—parrots, paradise ducks, *tuiis*, *ngoiros* and *karoros* (two gulls), *huias*, and *kautukus* (those two last being kept solely for their long tail and wing-feathers). They also formerly petted extremely, and made great fuss over, the then newly-introduced animals, as pigs, dogs, cats, and goats.‡ The *tuii* (or parson-bird), which was a great imitator and dearly prized by the ancient Maoris, was even taught a song,§ which it spoke tolerably well; of such first-rate talking specimens, however, I have only seen two, and those more than forty years ago. Here again, reviewing the past relative to pet animals,

* "Polynesian Mythology," p. 90. † "Trans. N.Z. Inst.," Vol. XI., p. 100.

‡ It was in 1841 that I first visited the Urewera tribes in the interior, at Ruatahuna and Te Whaiiti, near the head of the Whakatane river; and it was on this visit that I saw there (at Mangatepa) the most monstrous goat that I ever beheld! in bulk it was more like a young steer with prodigious flat horns, and was very mischievous. I saw it knock down sprawling big strong Maoris! who, however, generally gave it a wide berth, and so kept aloof. Inside of the fenced *pa*, or village, it was a perfect pest; for being *tapu* (*i.e.*, bearing the name of some one of their deceased chiefs), it must not be touched! This ancient custom of the old Maoris of naming their pets after some deceased relation, always insured both its safety (with the tribe) and its being tolerably well cared for; and if the said pet were at all viciously inclined it was sure to become worse through over-indulgence! I confess I was afraid of that quadruped, and for a long while could not believe it to be a goat! The Maoris, some years before, had obtained it from a ship on the East Coast.

§ The song which was taught this bird is in Prof. Lee's "New Zealand Grammar," p. 109; in its present state it is very imperfect.

one is led to enquire,—Why, seeing we have such a long line of testimony from the earliest times as to pets among this people, why is it there is nothing said or handed down concerning the *Moa* ?*

8. Lastly, there remain to be considered the several usages, or meanings, of this word—*Moa*, in the Maori language—exclusive of the term as applied to the extinct bird, or rather (by the old Maoris) to its fossil bones ; those may thus be classed :—1. Simply as a common noun for other things. 2. (still in its simple form) as an abbreviation of the proper names of other things, or of states of nature, or of persons. 3. As a name for places, and for men of the olden time, having also a word either prefixed or suffixed. 4. As a compound word used for names of things. 5. As reduplicated, and also with the causative particle prefixed.

(1.) The word *Moa* is also used for—1. That peculiar kind of boring instrument or drill† with which the old Maoris quickly bored the hardest substances known to them, as the green jade-stone, the thick part of a common black bottle, etc. (this little instrument was also by some tribes called a *pirori*) ; 2. For a raised plot, or long ridge for cultivation in a garden or plantation (a northern word) ; 3. For a coarse-growing sea-side grass (*Spinifex hirsutus*), which is also called *turikakoa*,‡ though this last term more properly belongs to its globular involucrate heads of female flowers, from the old use made of them ; 4. For a certain kind of stone ; or, for a layer or stratum of stone.

(2.) As an abbreviation ; mostly, however, in poetry, and in colloquial language : *e.g.*—

1. " Horahia mai ano kia takoto i te aio
Moa' i rokiroki."§

(speaking of a very great calm).

2. For a person :—

" Hua atu, e Moa,
Ka wareware ano
Ka' te hapai mai." ||

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* See *infra*, p. 96.

† See "Trans. N.Z. Inst.," Vol. I., "*Essay on the Maori Races*," p. 15 of Essay ; and Cook's Voyages, 1st Voy., Vol. III., p. 464.

‡ The term "turikakoa,"—*lit.* glad, or nimble knees—arises from the use formerly made of this globular head of flowers when travelling by the sea-side, in going before the wind over sandy beaches, or flats, when the tide is low ; one, or more, of them were gathered and pursued with agility and merriment ! such a simple device has often served to beguile many a wearisome journey on foot, with me and my party.

§ Sir George Grey's "Poetry of the New Zealanders," p. 41.

|| Grey's Poetry of New Zealanders, p. 15.

Here, however, this *may* be the full name; though I doubt it.

(3.) 1. As names of *places*:—*e.g.*,

*Te Moa-kai-hau. (See Legends and Proverbs, *ante*).

*Te Kaki-o-te-moa = the neck of the Moa,

*Pukumoa = belly, or bowels (of the) Moa.

Papamoa = Moa flat; also, *Spinifex* flat.

Taramoa = Moa's spur; also, Bramble (*Rubus australis*).

*Taramoa rahi = spur of the big Moa.

*Hauturu moanui = Hauturu big Moa:—*i.e.* possessing, or having had there, a big Moa. (There are several places named Hauturu).

*Moakura = red, or brownish, Moa.

Rauhamoa = said to be the name also of a bird.

*Moakatino = big, or fine, Moa or Moas.

*Otamoa = Moa eaten raw.

*Haraungamoa = Moa, or Moas, observed, or watched, or sought; or, the spot where the skin of a Moa was merely grazed, and it got off.

*Tarawamoa = stand, or stage, erected for hanging dead Moa.

*Moawhiti = startled Moa, or doubling Moa.

*Moawhanganui = Moa long waited for.

*Moawhangaiti = Moa briefly waited for.

*Moarahi = big Moa.

Moawhango = hoarse-sounding Moa.

2. As names of *persons*:—*e.g.*,

*Tawakeheimoa—this may mean, Tawake able to meet a Moa; or, Tawake for, or to be at, the Moa; or Tawake to yoke (*i.e.* hang, or put, a band, or rope around the neck of) a Moa.

*Te Kahureremoa—this may mean, the garment which fell off, or was thrown aside in fleeing from a Moa; or the garment of the person who ran on to, or over, a bed in a food cultivation (an offence); or the garment which was blown on to it.

Rongoiamoa,—the name of one of the men who is said, according to some legends, to have brought the *kumara* (sweet potatoe) to New Zealand. I have great doubts, however, of the termination of the word being derived from the animal *Moa*; it may rather be taken as *amoa*—carried on the shoulders; although the passive of that verb (*amo*) generally has the termination *hia*, sometimes *wia*; should it prove to have been derived from the *Moa*, then of course, it shows its high antiquity.

(Those three proper names are mentioned early in their history, and are all found in the two legends of Hinemoa, and of Te Kahureremoa; all three might also have been *originally* the names of ancestors in the long past!)

*Hinetemoa,—derived like Hinemoa (*ante*) but having a different meaning.†

*Te Awheramoa,—this may mean, to surround a Moa or Moas, through going behind; or, to relate, or point out, the precise place where a Moa or Moas had been seen.

Raumoa = Moa's feather: also, a variety of New Zealand Flax (*Phormium*): also, a blade of grass (*Spinifex*).

Himoa = ? to fish with a hook and line having a bit of Moa's bone (fossil) attached as a lure—as the Maoris formerly did at the East Cape.

Karamoa,—this may mean the same as Taramoa; the *k* being substituted for *t*, which is sometimes done.

(N.B.—Those preceding names of persons and of places have been obtained from all parts of the North Island.)

(4.) As a compound word for names of things, etc., *e.g.* :—

Raumoa,‡
Kauhangaamoa, } names of 3 varieties of New Zealand Flax (*Phormium*).
Karuamoa,

Hinamoa—a grub in wood, eating and making it rotten, and yet having a fair outside.

Rauhamoa—a large bird.

Taramoa,
Tataramoa, } Bramble (*Rubus australis*).

Tautauamoa—a dispute about a piece of land or bed (*moa*) in a cultivation; a quarrel between a few of the same tribe; a private quarrel.

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† Hinetemoa, a lady who lived eleven generations back (and an ancestress of Henare Toomoana, M.H.R.), was the wife of the chief Hikawera, and mother of Te Whatuiapiti, from whom the sub-tribe of Ngatitewhatuiapiti, residing at Patangata and Waipukurau in Hawke's Bay, are descended. On my formerly enquiring of the old chiefs of that tribe, why she obtained that name? the reply was: To show her high rank; she being the daughter of a great chief and of a great lady; hence, *Hine*—which was joined to that of *the one* great majestic *Moa* dwelling on the mountain Whakapunake, there being no other, so—*Hinetemoa!!*

‡ Raumoa, being the name for a variety of New Zealand Flax (*Phormium*), found on the West Coast (unknown by sight to me), and also a name for the leaves of the sea-side grass *Spinifex hirsutus*, a question here arises: (1) is the glaucous green *Spinifex* similar in hue to the said variety of *Phormium?* and, if so, (2) could the extinct bird Moa have had plumage of a similar colour in the eye of the old Maoris? (3) the hairy waving flaccid and closely growing *Spinifex* might also have carried a resemblance to the coarse body-feathers of the Moa. From strict etymological analogy, I should say, there must have been something in connection with the Moa which gave their names to those two plants; such, too, being in keeping with the genius of the ancient Maoris—as we may see (for instance) in the plant Rauhuia = the plume of the Huia (*Linum monogynum*), just because it bears its numerous white flowers at the tips of its branches, so reminding the old Maori of the white-tipped feathers of the Huia (*Heteralocha gouldi*).

Moai = peaceful, quiet—as the land in time of peace.

*Maimoa (*v.* and *n.*), = a decoy-bird—as a tame parrot, kept solely for that purpose ; to decoy by means of a tame bird, or bait.

This is another highly peculiar word, deserving of notice. The term is composed of two words, *mai* = hither, towards, hitherwards ; and *moa* = the name of the extinct animal. Is it possible that this word is derived from its very old original use as a term for the decoy for the living Moa? Nothing could have better expressed it. *Maimoa* = (come) hither Moa ; or the means (whatever that originally was) of making the Moa to come towards its hunter or his snares, or the better to secure it.

Some forty years ago I found the word largely and comprehensively in use among the scattered Urewera tribes in the mountainous interior ; it is also a general word.

*Taniwha-moawhango = a monster having a hollow cry like a hoarse Moa ; *or*, a monster-like Moa with a deep, hoarse, grating cry.

Another very peculiar proper name, a relic of the olden time, carrying almost its own interpretation ! At all events I can get no more. I have found only *one* old chief who had ever heard of the word, and that in his boyhood, but who could not explain it, save that that was the name of the creature, which was much feared (superstitiously). It is said that its hoarse, repulsive cry was heard always beneath in the earth (not unlikely some subterranean noise caused by volcanic action). Curiously enough, there is a river in the Patea country (interior) named Moawhango† (= hoarse-sounding Moa). This river runs in some places very deep below in the earth far beyond the light of day, and there, perhaps, may have a hoarse, hollow murmuring. Thirty-five years ago I crossed this river more than once on long poles thrown across the narrow surface chasm ; I could not see the water below in looking down through the rift !

(5.) As reduplicated, and also with the causative particle prefixed ; *e.g.* :

Moamoa, Hamoamoa, } Small spherical shining mineral balls, the size of marbles, found in the earth in various places ; as (by myself) near Cape Turnagain ; perhaps iron pyrites.‡

† *Vide* names of places, *ante.*

‡ I cannot resist venturing a remark here on these peculiar terms for those round shining stones : (1) Note the two words ; here we have *moa* reduplicated, meaning, commonly, less than moa (whatever moa may here mean), and, at the same time, having a frequentative tendency ; (2) then we have the prefix *ha*, which means, to resemble, to look like, to remind of ; can there be any allusion here to the metallic shining eyes, the ocellated appearance, of that one feather, which Hawea said was a feather of the Moa, and which closely resembled a peacock's tail-feather ? *Moa*, too, as we have seen, seems to be a kind of generic term for something round, spherical—*e.g.*, the round twirling drill, and the round flowering-headed *Spinifex.*

Whakamoa—to make up, or raise a plat, or heap of small stones or of earth; to make a raised bed of earth for planting, as in a food cultivation.

Whakamaimoa—to show kindness to rough, undeserving people; to make tame, civil.

Those several names of places, persons, and things, selected from a large number, would of themselves prove of great service to us in our researches if they could be depended on; as showing that, in some indefinite period in the far past, they applied to the animal in question. But in almost every case they may mean (or originally have meant) something else; for some of them may have had reference to a man, or men, named Moa; others (as Papamoa, Raumoa) to the sea-side grass called Moa, etc.

It was a common custom with the Maoris (and it is not yet abolished—indeed, it seems of late, during the last 20–25 years, to have been strongly renewed), to name a child after some ancestor of the olden time, which was not unfrequently repeated again and again in the course of succeeding generations, as may be found in their genealogical lists of descent—much the same as obtains among us. In some cases, too, the name of *Moa*, when derived from that of a man of ancient times, may have originally been only a part of his name—the beginning, middle, or ending* of it, as the case might have been—having subsequently had something else added thereto, as is now still being done by them. Nevertheless I must, in all fairness, allow that it seems to me that such names of places, etc., as Moawhiti, Moarahi, Otamoa, Haraungamoa, etc. (which I have marked with an asterisk in the foregoing list), are derived from the animal in question, *viz.*, the Moa, and that, too, when in a living state. And, if I am right in my deduction, or conjecture, such also serves to carry the age in which the Moa lived very far back indeed in the history of the Maori; as the names of *places* were before anything else with them, and were also never changed.† And this will the more strongly appear to be the case, for, as

* As obtains also very commonly in modern names among the Maoris, *e.g.*: Maa (for Makarini = MacLean), Mue (for Hamuera = Samuel), Neho (for Koreneho = Colenso), Tiu (for Matiu = Matthew), Pao (for Paora = Paul), Nahi (for Natanahira = Nathaniel).

† I may here give the translation of a letter from some aged chiefs on the East Coast, in answer to my repeated enquiries. It will also serve as a fair sample of many received on the same subject:—

"Friend Colenso, greeting to thee, etc. Listen to what we have to say in answer to thy many questions. We are not sufficient (or able) to reply. The reason of our inability is simply this, that our ancestors themselves did not know, and so that want of knowledge has come down to and is with us of the present day. It is so just because there was and is but one meaning of those several words [names of places], *viz.*: the name of the place itself. We know the bones of the *Moa* from old time; but the reason why such a name (of Moa or relating to a Moa) was anciently given to streams, to lands, to persons, to trees, to plants, this we don't know, we cannot explain; and herein is our great ignorance."

we have seen, apart from such we have no traces of the animal in question (save fragmentary and mythical ones) left in their language.

Additional Remarks.

A few other additional remarks I would also offer; gleaned, I may say, by the way we have come in our enquiry:—

1. The very peculiar names (*Rau-o-piopio* and *Kowhakaroro*) repeatedly given by the chief Hawea to that "one Moa's feather" he had seen:—observe (1.) that such is *not* that of the bird itself; it is not here called a Rau (or Piki) Moa=the plume or fine feather of the Moa; while such is commonly the case with the feathers of other birds which are prized for head decoration,—which are always named after the bird itself; as, Rau (or Piki) huia=the plume or fine feather of the huia,—Rau (or Piki) kotuku=the plume or fine feather of the kotuku (white crane),—Rau parera=the plume of the duck, etc., etc. (2.) That the term *Rau-o-piopio* would properly mean—feather, or plume, of (the bird) *Piopio;* and there is a bird of that name known to the Maoris; or, rather, I should say, there are three! all widely differing from each other:—(*a.*) the New Zealand thrush (*Turnagra crassirostris*);—(*b.*) a small reddish bird;—(*c.*) a bird (unknown to me) said to have been a kind of ground game and largely used as food, but now extinct!* Of these three birds I only know the first one, having both seen and heard it in the forests on the west side of the Ruahine mountain range, although it is a South Island bird, and but rarely met with so far north as Hawke's Bay; it is also called by the Maoris *korokio*, and *koropio;* by this last name it is best known in these parts. As the first of these three birds (the thrush) is not unfrequently mentioned by the Maoris in their songs, owing to its cry (*piopio*), and also in their proverbs, I have made special enquiry, whether the said "one feather" bearing its name could have belonged to it; but met with a direct negative. Neither have I succeeded any better in all my endeavours to learn why that one feather should have obtained those two long names. (3.) The other term for that one feather, "*Kowhakaroro*," has, curiously enough, a peculiar meaning, that is etymologically,—a reference to another bird, the *karoro*, or large white and brown gull (*i.e.*, it *may* have had some such meaning). One meaning of the word *kowha* is,—favourable consideration, kind gracious words or dealings, a kind parting word, regret, a gift, *souvenir*, etc. And the karoro, with its long and melancholy cry, is also mentioned in their legends, as causing them, the old Maoris of ancient

* Nearly all that I know of this bird is from a letter from a Maori chief, written in 1873, in which he says:—"The foreigner introduced the dog and the cat, which completely destroyed the food-birds of this island,—the weka, the kiwi, the kaakaapoo, the piopio, and many other birds."

days, to lament when they heard it;* so that I can well perceive how those two words put together would form an appropriate name, among such a poetical and imaginative race, for such a feather only so used, *viz.*, the last melancholy parting gift of the karoro. But still this may be fanciful on my part.

2. That "one feather" is also plainly and fully described by Hawea as closely resembling the tail-feather of the peacock. Now, here three things are observable:—(1.) That such is not the case with any Struthious bird known, especially with the remaining New Zealand one, the kiwi (*Apteryx*, sp.); (2.) that, curiously enough, a similar glowing description is also given of another extinct New Zealand bird of large size, *viz*,, the *hokioi;* which bird, however, had been really seen by the old Maoris of the generation just passed away, and by them particularly described. It was said, by an intelligent aged Maori, seven to eight years ago, when writing of this bird:—"Our forefathers saw that bird of former days, the hokioi; we of this generation have never seen it, for it has become extinct, but only of late. According to what our forefathers have handed down to us, the hokioi was a very strong bird, especially on the wing; it was very much bigger and stronger than the hawk, with which, however, it was always at feud. Its habitat was on the mountains, never in the lowlands. It was seen by our fathers when flying, on its days of coming down, or flying abroad; but this was not every day, because its home was in the mountains. Its appearance or colour was red and black and white, having plenty of feathers; some of which were also bright yellow, like the colour of the flowers of the *kowhai* tree (*Edwardsia*), and some were glistening green, like those of the small parroquet; it had also a beautiful tuft, or plume of feathers on its head. It was a very big bird indeed." (3.) If that "one feather" was not a stray feather from the recently extinct bird *hokioi*, which also lived away in the mountains,†—it may have been a feather from a Peacock, brought hither by those whaling ships from Sydney or Tasmania, which came here often early in this century to refit, etc., and who would have quickly known how very much handsome feathers were in request, both in New Zealand and in the other South Sea Islands; of which, indeed, the barter had been commenced in the very time of Cook,‡ and of which those who came after him in those seas, of course knew.

Here I may also remark, that the old Maoris who first saw the Europeans, as a rule, named the *new* and strange things (especially animals) in

* It was the hearing the melancholy wailing of the karoro flying in the Upper Rangitikei River, that caused the chief Kahungunu to burst out into his passionate lament. (*Vide*, p. 91, *ante.*)

† *Vide* Hawea's statement of that "one feather" having been found in the mountain district, blown down by the wind to the branches of a white pine tree. (*Ante*, p. 83.)

‡ *Vide* "Cook's Voyages," second voyage, Vol. I., p. 318; and in other places.

accordance with their own ideas respecting them;* hence they called the horse, the *kuri* (or *kararehe*) *waha-tangata* = the dog (*or* beast) which carries a man, and this was the name by which the horse was long known in the Bay of Islands, where it was first introduced; so with the sheep which was called *pirikahu* (from its wool), and the cat = *ngeru;* while the fowls, which were given by Cook to the old chief who boarded his ship off Blackhead, on the East Coast,† were called by them (in my time) *koitareke pakeha* = foreign quail.

3. In the proverbs I have quoted concerning the Moa, the first one runs,‡ "*He koromiko te wahie i taona ai te Moa*;" and I have there said that the verb used in the proverb for cooking, *tao* (*taona*, pass.), is that which points out the particular mode, *viz.*, baking in a ground oven; but here it may be observed, that the common verb for burning, *tahu* (*tahuna*, pass.), is of similar short pronunciation, and is also sometimes used for cooking, and such may have been originally here intended,§ as we find another analogous verb for roasting, scorching, *tunu* (*tunua*, pass.), is also used in those few songs‖ in which the Moa is mentioned; this supposition is further strengthened by what is uniformly said in their legends of its sudden disappearance by fire. To this I may also add, that frequently in my early travelling in this country (some 45–46 years ago), my Maori companions, on nearing a *pa* or village among their own tribe (especially if emerging from a forest near), would call out, "*Tahuna he kai,*" and "*Tahuna he kai ma matou!*" instead of "*Taona he kai,*" etc., although this latter was intended (Bake some food for us); as the firewood in the ground oven must be first burnt (*tahu*) before that the food could be baked therein (*tao*).

Conclusion.

It will, I think, be seen that I have written exhaustively on this subject, at least I have endeavoured to do so, and that for two reasons:—

1. I wished to tell all the little I knew—all I had subsequently gleaned since first publishing about the Moa in 1842; in hopes of others hereafter following up the quest.

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* Nor is this to be at all wondered at, for the Greeks and the Romans did just the same thing to new animals; hence the Greeks named the animal from the African rivers, Hippopotamus (river-horse), and the Romans the Elephant, Lucas bos (the Lucanian ox), because they were first seen by them in Lucania. (Pliny, *Nat. Hist.*, lib. viii. c. 6: Varro, *de Ling. Lat.*) I am led to mention this here in a note, because some of our "superior race" colonists have ridiculed the Maoris for so doing, and in doing so have displayed their own ignorance!

† *Vide* Trans. N. Z. Inst., Vol. X., p. 146. ‡ Page 84, *ante.*

§ It should not be overlooked, that it is only of late years the Maori Proverbs, Songs, etc., have been reduced to writing, so that it would be very easy for a writer to make such a slight error as *taona* for *tahuna*, especially if he were a young person writing down old and almost obsolete sayings from the dictation of aged men.

‖ *Vide* page 87, *ante*

2. I have, in so doing, finished my work; I shall not again write on this topic.

For my own part I am, as I have long been, satisfied. My own fresh labours in this direction have only served the more fully to confirm me in my old views* as to the very great antiquity of the living Moa in this North Island of New Zealand.

Few, very few, will be fully able to comprehend the immense amount of labour this enquiry has cost me; the amount of time, writing, and patient research consumed would be almost incredible, especially in my seeking after ancient names of places and of persons containing the term *Moa*,—and what a very small result! I have often been led to think of the amount of toil spent in obtaining two dishes for the banquet of Heliogabalus, *viz.*: of ostriches' and nightingales' tongues! and yet all devoured in an hour.

In fine, the conclusion I have come to is this:—

1. That the bird *Moa* (some of those of its genera and species) was really known to the ancient Maori.

2. That such happened very long ago, in almost pre-historical times; long *before* the beginning of their genealogical descents of tribes, which, as we know, extend back for more than twenty-five generations.

3. That this conclusion is the only logical deduction from all that I have been able to gather; whether myth, legend, proverb, song, or the etymological rendering of proper names of places, persons, etc.

I will conclude my paper in the highly suitable words of Tacitus, when writing on another celebrated bird of great antiquity, which had given him and other philosophers before him an immense amount of labour—I mean the *Phœnix*. Tacitus says: "In the consulship of Paulus Fabius and Lucius Vitellius, after a long series of ages, the bird called the Phœnix arrived in Egypt, and furnished the most learned of the natives and Greeks with occasion for much speculation concerning that marvel * * * But the accounts of antiquity are enveloped in doubt and obscurity * * * whence some have believed that the present was a spurious Phœnix * * These accounts are not entitled to unqualified credit, and their uncertainty is by the admixture of matter palpably fabulous: but that this bird has been at some time seen in Egypt, is not questioned."†

APPENDIX II.

1. *Of Dr. Ernest Dieffenbach's opinion on the Moa.*

Among the very few early scientific writers on New Zealand, who had themselves travelled in and partially explored the country, I may here

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* *Vide* Trans. N.Z. Inst., Vol. I., "Essay on the Maori Races," p. 58 of Essay.

† *Annals*, lib. VI., c. 28.

mention Dr. E. Dieffenbach, the Naturalist to the New Zealand Company. This gentleman was here in the years 1839–1841, and I had the pleasure of being acquainted with him while he stayed in the Bay of Islands, where, for some time, he lived next door to me. He saw and "overhauled" all my specimens (even then rich in shells, and insects, and ferns, and in geological samples), and many conversations we had respecting the *Moa*. In his work, in two volumes, on "New Zealand," he twice mentions the *Moa*, but only in a very slight way; in fact, he, then, could not say any more, for he did not himself collect a single *Moa* bone, although he was industrious in obtaining all kinds of natural specimens. He saw, however, what few broken bones I had at that time, obtained from near the East Cape through the Christian Maori teachers, who had been sent there by us after our early visit made there in January, 1838. Dr. Dieffenbach thus alludes to the *Moa* in his work :—"The natives (of Taranaki) could not understand what induced me to ascend Mount Egmont; they tried much to dissuade me from the attempt, by saying that the mountain was *tapu*;* that there were *ngarara* (crocodiles) on it, which would undoubtedly eat me; the mysterious bird *Moa*, of which I shall say more hereafter, was also said to exist there, But I answered that I was not afraid of those creations of their lively imagination," etc. And again, in writing of "special changes in New Zealand," he says :—"If a geological cause, such for instance as a diminution of the size of the island, attended by an alteration of climate and a diminution in the means of subsistence, has contributed to the extinction of the struthious *Moa* in New Zealand, and of the Dodo in the Mauritius, it is no less sure that, since New Zealand began to be inhabited by its aboriginal race, the agency of man has effected a part of that eternal fluctuation in the organic world, the knowledge of which has been one of the most important results of modern science,"† And this is all he says! Some time after, however (in 1845), we find him reading a paper "On the Geology of New Zealand," before "the British Association for the Advancement of Science,"‡ in which he says :—"That he has examined into all the traditions respecting the existence of the *Moa*, or great bird of New Zealand, and concludes that it has never been seen alive by any natives of New Zealand; the rivers in which its bones have been found flow between banks from thirty to sixty feet high, and, as they are continually changing their course, the remains of the *Moa* may have been derived from tertiary fluviatile strata."§ (Of course I cannot help thinking the Doctor was indebted to my published paper on the *Moa* for this information, as it is

* *Lit.*, strictly forbidden, or preserved.

† "Travels in New Zealand," Vol. I., pp. 140 and 417.

‡ At their fifteenth meeting, held June 21, 1845.

§ From the 'Tasmanian Journal of Natural Science," Vol. II., p. 451.

given in almost my very words; nevertheless, if not wholly original on his part, I bring Dr. Dieffenbach forward as a valuable witness, and a supporter of my early published opinions).

2. *Of the later opinions of Sir George Grey and of Mr. Weld (with others of lesser note), stated, or adduced, in some of the past volumes of the "Transactions of the New Zealand Institute."*

Having read them, I cannot allow this (my last!) opportunity to pass without briefly noticing them. Sir G. Grey is stated to have said that he had heard from the Maoris of their general knowledge of the *Moa*, and of its recent extinction, in common with some other birds; and Mr. Weld relates of a Maori informing him how the bird kicked like a horse, etc., etc. *To me* all this is easy enough. From January, 1838 (when I first heard of the *Moa*), down to 1842, and later, no man could possibly have done more than I did in my quest after it, and no man could have had better opportunities; by enquiry everywhere, personally, in travelling (and I, then, travelled *largely*); by letters to a distance, in New Zealand, to both Europeans and Maoris; and by Maoris (my own lads), returning to their homes in all parts from our Mission Stations at the north;* and through many others of them whom we had redeemed from slavery and restored to their homes and tribes, and with whom I subsequently long corresponded;—and, I again assert, that it was through me that the Maoris generally got to know of the *Moa* having been a *real* (or common) *bird*. I showed them, repeatedly, at the station, the plates in Rees' Cyclopædia,† containing all the *Struthious* birds, and told them of their habits, etc., and of my opinion of the extinct *Moa;* that information was carried almost everywhere (with, no doubt, many additions),—and that information, together with simple leading questions on the parts of the enquirers (especially when put by the Governor of the Colony, or by any superior,—which, according to Maori etiquette, would not be negatived even if wrong)‡—and, also, with but a small knowledge of the Maori tongue on the part of the Europeans, fully explain all *to me*, and that very satisfactorily. Here, I cannot help remarking, in order to make things clear, that words would fail to show to the colonist of to-day—or (say) of the last thirty to thirty-five years—how highly different it was with the Maori before this Colony was established, and for a few years after; I mean, particularly, with reference to the making of those enquiries. They were carried everywhere throughout the length and breadth of the North Island; they were the constant theme of conversation among the Maoris, who then had little of a novel nature to

* *Vide* Trans. N. Z. Inst., Vol. XI., p. 110. † Vol. V., Natural History, plates.

‡ *Vide* Trans. N. Z. Inst., Vol. I., p. 49 of "Essay on the Maori Races."

talk over,—increased, from the fact of rewards being offered for bones, feathers (if any), and for information.

Mr. Travers' paper (*compilation*)* I should not care to notice separately, were it not for a letter contained therein, written by my good friend Mr. John White. (I could only wish, in this as in some other matters, that Mr. Travers would write of what he himself knows of things). Some portions of Mr. White's letter astonish me. For Mr. White had lived at the North among the Ngapuhi tribes many years (just as I had), and to that information said to be obtained from them he adds more—even to a *Moa* which was "killed" *here* in modern times "near to Waipukurau!"† where I have also been living nearly forty years!! and where I had conversed with those old Maoris who saw Cook, but who knew nothing of the *Moa!* (I fear this *Moa* "killed here near to Waipukurau" was much like mine which lived on Whakapunake, or that one mentioned by Dr. Dieffenbach as said to be living on Mount Egmont!) Yet, not only this last statement, but nearly all that Mr. White says is equally new to me. Now I recollect when Mr. John White came to New Zealand (a boy); it must have taken him some time to learn the language—before at all events he could talk clearly about such a highly recondite subject as the *Moa*, not being then particularly drawn thereto—and when talked of, I presume, such was only very occasionally, and then but slightly; whereas with me and others it was a matter of deep, extensive, and persistent enquiry extending over years. Remembering, also, how Dr. Dieffenbach and others‡ laboured to glean something about the *Moa* in those same northern

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* *Vide* Trans. N. Z. Inst., Vol. VIII., p. 58.

† *Vide* my genealogical note on Hinetemoa, p. 95, *ante.*

‡ Here I should briefly mention a few of those scientific gentlemen who were also in the Bay of Islands and its neighbourhood during those years (omitting mere passing visitors), and who all through their interpreters zealously sought after any remains of the *Moa*, now especially coming into prominence; *viz.*, the Antarctic Expedition, under Sir J. C. Ross, R.N., with his several able naturalists (including Sir J. D. Hooker), who wintered there; the United States Exploring Expedition, under Commander Wilkes, U.S.N.; the several French ships of war and discovery, under Admiral Dumont D'Urville, Captain Cecille, Captain L'Eveque, and others; and many other private gentlemen, as Mr. Busby, Mr. Cunningham, the Rev. W. C. Cotton, and Dr. Sinclair,—but whose gains were *nil!* Through my residing in the Bay and close to the anchorage, I saw and knew them all, and of course had much conversation with them about the *Moa*, and its history. And last, though not least, there were the many "stores," or traders settled on shore in various parts of the Bay, who had very extensive dealings not only with the shipping but with the Maoris; who, be it further observed, were now everywhere breaking soil in seeking after the new commercial product, *Kauri* resin. Those traders would have been sure to have picked up readily any specimens of *Moa* remains, or any fragments of its past history,—but they, too, got none!

parts before that Mr. White knew Maori,—I confess I feel strange. The only ready solution to my mind is that Mr. White in this matter has been half deceived; that is, he heard something long ago (just as Sir G. Grey and others heard it), and the rest has been in the course of many years evolved therefrom or added thereto, or both.

3. *Of the Rev. R. Taylor's statement, which he calls "An Account of the First Discovery of Moa Remains."**

I have often *of late* read and considered with no small astonishment, what Mr. Taylor has here stated. I could enter into it fully, dissect it, and say a good deal upon it; but, as I have hitherto kept myself from doing so, I will still forbear. This much, however, I deem it right to say (bearing in mind the adage: "*De mortuis nil nisi bonum,*" to which I would add—*vel verum*),—1. If Mr. Taylor really made those early discoveries and in that way, why did he not make them known? Like myself, he, too, had been early elected a member of the "Tasmanian Society," both of us together in 1841, with the Rev. W. Williams, and other residents in New Zealand;† soon after which Mr. Taylor wrote a paper on the "Bulrush Caterpillar of New Zealand" (*Cordiceps robertsii*), which he sent to Tasmania, and it was published in 1842, in the *first* volume of the "Tasmanian Journal of Natural Science;"‡ while mine on the *Moa*, though written early in 1842, was not published in that "Journal" until 1843, and that in the *second* volume: my first papers being on some of our New Zealand Ferns. 2. Mr. Taylor says, "The chief readily gave me the (fragment of a) bone for a little tobacco, and I afterwards sent it to Professor Owen, by Sir Everard Home; this took place in 1839. . . . . I think I may justly claim to be the first discoverer of the Moa."§ But in Professor Owen's paper on the *Moa*, he gives *verbatim* Mr. Taylor's letter to him, which he received through Sir Everard Home; it is dated "Whanganui, February 14, 1844" (five years after!) and in it, Mr. Taylor, in writing of his *single* visit to the East Cape with the Rev. W. Williams in 1839, on his first arrival in New Zealand, says, (after) mentioning his discovery of *Moa* remains at Whaingaihu—? Whangaehu, "*I have found the bones of the Moa in this stratum*, not only in other parts of the Western, but also *on the Eastern Coast and at Poverty Bay;* from whence in 1839 *I procured a toe of this*

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* Trans. N. Z. Inst., Vol. V., Art. III.

† *Vide* "Tasmanian Journal," published lists of members.

‡ In that paper Mr. Taylor says: "The *Aweto*" (*!*)—*Cordiceps*—"is only found at the root of one particular tree, the *Rata*, the female *Pohutukawa*. * * * These curious plants are far from being uncommon. The natives eat them when fresh (!) The seeds of the fungus are nourished by the warmth of the insect," etc., etc.—*Tasmanian Journal*, Vol. I., p. 307.

§ Trans. N. Z. Inst., Vol. V., p. 93.

bird."* This, however, is widely different, both as to *date* (of his first sending to Professor Owen), and also as to the extent of his "*find*" at the East Cape. He only specifies the, so-called, "toe," which is quite correct, as I had myself stated in my early published paper;† he says nothing here, however, of "the fragment of bone;" nevertheless, he goes much further—actually saying that "*he had found bones in that same kind of stratum at East Cape and at Poverty Bay!*" All I can say is: If so, why did he not make them known? Mr. Taylor was well-known not to be at all backward in writing of every thing; and while at the North he had plenty of time to call his own. In this same letter to Professor Owen, *(supra)*, Mr. Taylor goes on to say: "The Kakapo or Tarepo is about the size of a turkey, and from its habits, nature, and other circumstances, *seems so closely to resemble the Dodo, as to lead me to suppose it is the same*," etc. 3. I well remember Mr. Taylor (with whom I *was* for some time on the most intimate terms of friendship),‡ complimenting me highly on his receiving that part of the "Tasmanian Journal of Science" containing my paper on the *Moa*. [Those parts came regularly through my hands for distribution to the members residing in New Zealand, owing to my living near to the anchorage.] Whenever Mr. Taylor came from the Waimate to the Bay, he always called, and saw repeatedly all my collections, from which he obtained many specimens. Briefly reviewing the past, I cannot but conclude that Mr. Taylor's memory must have failed him when he gave his *last* statement at Wellington, in 1872, in which, I think, many incidents of the past relative to the *Moa*, are jumbled together as to date and sequence; which, also, from the Editor's note attached, seems to have been done rather hurriedly. *At present* I make no further remark concerning the many strange (? erroneous) statements with which his published works on New Zealand abound; on a future occasion, however, I may have to notice some of them.

4. *Of a remark made by Mr. Vaux, in his paper, "On the probable origin of the Maori race."*

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* "Zoological Transactions," Vol. III., part 4, p. 327.

† *Vide* "Tasmanian Journal," Vol. II., p. 85; and Dr. Dieffenbach also saw it. At that time, and for several years before and after, I was residing at Paihia in the Bay of Islands, while Mr. Taylor's home was at the Waimate, then a long day's journey inland. I saw him on his return from the East Cape as he landed at Paihia, and with him tried to match his "toe" (or claw) to my few bones of the *Moa*, but it would not fit; at that time Mr. Taylor had none, neither had Mr. Williams. The so-called "toe," which was very black and solid, resembled a bit of water-worn and rolled *Obsidian* more than anything else; yet it might have been a claw; but, if so, greatly worn, and with dull and rounded edges. I only saw it once and for a short time.

‡ As a proof of this, see "Tasmanian Journal of Science," Vol. II., p. 244, for an account of a fine fossil *Terebratula* (*T. tayloriana*), which I discovered far away in the interior in 1841, and dedicated to him.

In justice to myself—if not also to Professor Owen and to Mr. Rule—I had intended noticing a statement made by Mr. Vaux in his above-mentioned paper, in which he says that "Bishop Williams and the Rev. R. Taylor, in 1839, were the first to discover the remains of the *Moa*;"* but, owing to the great length of my paper, I am obliged to omit doing so; merely saying here that *I deny it.* My grounds for so speaking will be found in what I have already written upon it (*supra*). Mr. Vaux, evidently, had not seen my early-published paper on the *Moa*, neither those of Professor Owen, and of Dr. Mantell. There are also other matters of high importance in Mr. Vaux's paper respecting the Maoris (for which he has mentioned me); to them, I hope to return ere long.

5. *Of sundry early English published scientific testimonies.*

In conclusion, I may be permitted to call attention to the following testimonies in connection with the foregoing; and I do so the more readily because they were all spontaneously given by gentlemen of the highest standing in their respective scientific pursuits, and written, and published, and spoken of publicly (in lectures, etc.) by them at a very early period. I mean:—

(1.) Sir W. J. Hooker, K.H., etc., etc., the very eminent Botanist, formerly Director of the Royal Gardens at Kew, who, in the *London Journal of Botany*, for January, 1844, Vol. III., p. 3, mentions approvingly my paper on the *Moa*, and the bones I had sent through him, in 1842, for Professor Owen.

(2.) Professor Owen, F.R.S., etc., etc., the eminent Naturalist and Osteologist, who—both in his papers on the *Moa* (*Dinornis*), "*Zoological Transactions*," Vol. III., part 4, p. 327,—and, also, in his kindly and of his own accord, republishing in the "*Annals and Magazine of Natural History*," 1844, Vol. XIV., p. 81, my early paper on the *Moa*,—has borne a similar testimony.

(3.) Dr. Mantell, F.R.S., etc., etc., the celebrated Geologist and Osteologist, has also done the same, and that, too, at various times; particularly in his work entitled "*Petrifactions and their Teachings*," pp. 93, 94, and 487; and also in his very able and lucid paper (doubly interesting to us here in New Zealand), "On the Fossil Remains of Birds, collected in New Zealand by Mr. Mantell of Wellington," published in the "*Quarterly Journal of the Geological Society*," February, 1848, Vol. IV., pp. 225–241 (*passim*), where Dr. Mantell says:—"I do not deem it necessary to enlarge on the question whether the *Dinornis* and *Palapteryx* still exist in New Zealand; on this point, I would only remark that Mr. Colenso, who was the *first* observer that investigated the nature of the fossil remains with due

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* Trans. N. Z. Inst., Vol. VIII., p. 11.

care and the requisite scientific knowledge (having determined the struthious affinities of the birds to which the bones belonged, and pointed out their remarkable characters, ere any intelligence could have reached him of the result of Professor Owen's examination of the specimens transmitted to this country), has given, in his masterly paper before quoted, very cogent reasons for the belief that none of the true Moas exist, though it is probable the last of the race were exterminated by the early inhabitants of these islands." (*Loc. cit.*, p. 235.)

Addendum.

Napier, *October* 24, 1879. I was very much surprised this morning, on finding (and that by the merest chance, in looking into the "Index, Vols. I.–VIII.") that Mr. Stack, of Canterbury, New Zealand, had some time ago written a short paper containing those passages from Sir G. Grey's "Poetry of the New Zealanders" which I have in this paper adduced respecting the Moa. I had never before this morning seen Mr. Stack's paper; no doubt this was owing to its being placed in the Appendix at the end of the volume,* and to its extreme brevity. However, had I earlier seen it, I could not have accepted his translation of those passsges referred to, still less his remarks thereon. New Zealand poetry and legends cannot be rendered by any Maori scholar in the South Island; besides, their myths and legends are not now to be found there in their integrity; indeed, such could not reasonably be expected among such a small remnant of Maoris living isolated among settlers.

Art. VII.—*Contributions towards a better Knowledge of the Maori Race.*

By W. Colenso, F.L.S.

[continued.†]

[*Read before the Hawke's Bay Philosophical Institute, 9th June*, 1879.]

—— "For I, too, agree with Solon, that 'I would fain grow old learning many things.'"
—Plato: *Laches.*

On the Ideality of the Ancient New Zealander.

Part II.—Proverbs and Proverbial Sayings.

I have long believed that there is much truth in that compendious remark of Lord Bacon, *viz.*, that "the genius, wit, and spirit of a nation are discovered by their proverbs." It is in them, no doubt, that a philosophical mind will discover a great variety of curious knowledge, particularly when

* Trans. N. Z. Inst., Vol. VII., Appendix, p. xxviii.

† For Part I. see Vol. XI., Art. V., p. 77.

(as in the case of the New Zealanders) the nation has no literature, or, rather, no *written* records and books. It has been deliberately affirmed by a learned modern writer well acquainted with his subject, that there are 20,000 proverbs among the nations of Europe alone. Many of these have been handed down from ancient times; not a few from the Greeks, who also borrowed largely from the Eastern nations. Such proverbs were long confined to oral tradition (just like these of the New Zealanders); for, as it has been truly observed, "Proverbs were before books." The most ancient, as well as the most refined and civilized of nations, have ever used them, and that effectively. We find them pervading all classes of literature—religious, moral, scientific, historical, domestic, social, and humorous; we find them made use of in the Old Testament from before the beginning of the Hebrew nation; we find their wisest king (with his wise men) compiling a book of *Proverbs;* we find the Great Teacher himself several times using them in his discourses, and after him Paul and Peter—as is recorded in the New Testament—borrowing them, too, from an alien people. And, in more modern times, Shakespeare, John Bunyan, Swift, Walter Scott, and other British standard writers, have also used them to great advantage. We all know what was Lord Chesterfield's opinion concerning them, *viz.*, "Never to be used by a man of taste or fashion;" and possibly that statement may have served to drive them out of polite conversation—in England, at least; but such was not the Court belief in the reigns of Elizabeth, James, and Charles. The Chinese, the Japanese, and the Hindoos abound in many wise and pithy sayings. The Italians and the Spaniards are still greatly addicted to the use of proverbs, especially the latter; witness Cervantes, the writer of "Don Quixote." How, indeed, could the famous Governor of Barataria have possibly succeeded without them? Proverbs of all nations in common use are not only "the philosophy of the vulgar," but they contain fragments of wisdom, they are true to nature, and are suited to the people in general by whom they are used. They reveal to us their ancient ways of thinking, and consequently their manner of acting. I have little doubt that not a few of the mottoes of our old nobility may be well accounted for in this manner—something of note in act or word that originated with, or in the times of, the founder.

To the ancient New Zealanders, however, the great value of their proverbs and proverbial sayings appeared in their oratory, of which they were passionately fond, and in which they excelled. At such times (as I myself have heard them with delight some 40–45 years ago!) their orators, by some well-chosen, some fitting proverb, carried everything before them, winning over their attentive auditory as if they were but one man! In which, no

doubt, they were ever largely aided by the very genius and structure of their noble Maori language, it being so highly terse, pregnant with meaning, and abounding in paronomasia and antithesis.

Not a little has been written on the true definition of a proverb. A modern one of Lord John Russell has caused some noise, and obtains with a large number, *viz.*, "The wit of one man and the wisdom of many;" but for my part I adhere to the older and more homely definition of Dr. Johnson, *viz.*, "A short sentence frequently repeated by the people; an adage, name, or observation."

I early commenced collecting the old Maori proverbs, as I saw of what great power and use they were in addressing the Maori people, and I have now more than 1200 (perhaps 1400). I have not, however, sought any for several years, and I have good reasons for believing there are not a few irrecoverably lost, and hundreds still unknown to Europeans. Lately I have been going over what I had secured (in part for this paper), and I have been again much struck with their appositeness, propriety, and usefulness, indicative of a high class of thought; though still more struck, in my attempt at classifying them, with their wide range, embracing almost everything objective or subjective that could possibly have entered into the mind of a New Zealander. No doubt not a few of them are of great antiquity, as they refer to the celebrated heroes and exploits of the olden time, of the beginnings of their traditionary times; to the legends of their demi-gods, and to animals and plants now and for some time extinct. Here, among these latter, I had long hoped to find something referring to that almost mysterious animal the *Moa*, something as to its size, form, powers, appearance, habits, food, uses, etc., that would have been of real service to us of to-day, but I have sought in vain! True, I have (as I by-and-bye hope to show*) obtained *eight* ancient proverbial sayings respecting it, but their very abrupt, primitive, and legendary style, and esoteric or hidden meaning, carry it very far back into the night of history! In this, however, we have but another phase of that same oneness of early testimony of the olden time, which (as I have already observed†) we find in their legends and myths and ancient stories; and, as we shall yet find, also in their songs.‡

I have said that I was much struck in reviewing the very wide range whence the ancient New Zealanders had drawn their proverbial sayings; but there is still another more remarkable and noteworthy feature respecting them, which I wish particularly to bring before you, and which, indeed, is one of the principal reasons for my writing this paper; and that is what

* *Vide* paper on the Moa; Art. VI., Part II.

† *Vide* Vol. XI., Part I. of "Contributions, etc.," p. 83.

‡ *Vide* Part III. of "Contributions, etc.," *infra.*

you and almost all colonists of to-day could never expect to find; on the contrary, you would, I am inclined to believe, look for the very opposite. It is, the very large number of their proverbs inculcating industry (both of man and woman, chief and slave); their giving undivided attention to the regular planting and harvesting of their crops; in favour of perseverance, patience, and endurance; the preference of peace to war; the praise of hospitality and kindness, of deliberation, counsel, and prudence; sound advice to women and to children—to the young men in the taking a wife, and to young women in taking a husband; their openly exposing (even by name!) the mean and stingy conduct of their own greedy, inhospitable, and unkind chiefs;—also, all cowardly and rash conduct on their part; and against ill-manners, rudeness, and ill-temper; against laziness, begging, gluttony, slander, grumbling, and lying; the complaining of trifles and of weariness at work or in travelling. I repeat, I can well imagine you would quite expect to hear the contrary to all this. Those sayings of theirs—once "familiar in their mouths as household words"—are strong indications, however, of what the ancient New Zealander really was, and of what good human qualities were prized by him.

Referring again, briefly, to the very wide range of their proverbs, the New Zealanders seem to have drawn largely from Nature,—her various works and operations; clearly indicating that he had been not only a very attentive natural observer, but well able to make correct deductions; for, in addition to those already mentioned, he had proverbs drawn from the regular appearances of the stars, planets, and constellations,—from the varied seasons of the year,—from the several winds and meteors,—from the ever-varying forms and colours of the clouds, and of the rainbow,—from the sea, calm and raging,—from tides and currents, rocks and shoals,—from fountains, rivers, rain, hail, snow, and ice,—from the weather,—from mountains and hills, and from stones, both hard and soft,—from fire and smoke,—from cold and heat,—from times of drought, and of floods, and of overflowing rivers, and from boiling springs and earthquakes. I have attempted to classify them roughly, and I find that:—(1.) From *Animals* (exclusive of Man) he has derived 150 proverbs and proverbial sayings,—which may be divided thus,—of Mammals (including the Seals, Whales, and Bats), 22;—of Birds (including the largest and the smallest, extinct and present species), about 65:—of Fishes, both sea and fresh-water, about 30;—of Shell-fish and Crustaceans, a dozen;—of Reptiles and Worms about the same number; and another dozen, or more, of Insects, including larvæ. (2.) From *Plants* and their uses,—including the largest timber trees, and the tiny moss, and seaweeds,—their timber, fruits, edible roots, textile fibres, resins, gums, and scents,—upwards of 70. (3.) From *Natural*

Inanimate Objects, and the operations of Nature already mentioned, about 100. (4.) From *Man*,—both chief and slave, male and female, old and young,—the parts of the body, his ailments, infirmities and sins,—his faculties, habits, and great powers,—nearly 100. I also find (5.) that from their *Gods, demi-gods, and ancient heroes*, mythical or real, they derive above 100; and a like number, incidental, occasional, and peculiar, of particular or *celebrated men;* (6.) from *Numbers*, about a dozen; (7.) from *Artificial Objects*,—such as, the House and its belongings, the Canoe (their ship!) and its equipment,—from their many and varied garments,—from war, fishing, fowling, and husbandry implements,—from their artificial paper kites and other games,—from their many Ornaments of greenstone, birds' feathers, and shark's teeth,—and from their scented necklaces, anointing oils and various cosmetics, nearly 200; while (8.) for love, affection, sympathy nobility and greatness,—kindness and hospitality,—industry (both of men and women), quickness, and expertness,—endurance, patience, deliberation, counsel, and advice,—peace not war,—courage and bravery,—and, *against* ill-temper, ill-manners, and ill-nature,—laziness both of men and women,—weariness and grumbling,—slander, shame, lying, and theft,—begging, idleness, and gluttony,—disobedience, fear, cowardice, anger, hate, rashness, and threatening,—superstition and omens, they have more than 200; of which, it may be observed, that by far the largest number are in support of industry, and *against* slander, gluttony, and laziness—their present three common vices. "*O tempora! O mores!*"

The colonist of to-day—aye, and most, too, of those of the last ten, or even 25–30 years—who have had many dealings with the Maoris, or who have had ample opportunities of observing them closely, will naturally feel a little peplexed at this; as, I fear, their own experience would generally tell a different tale. But it must be borne in mind that the present generation is a widely different one from their forefathers,—inheriting nearly all their vices (with those heavier and commoner ones too surely attendant on "civilization!"), and but little of their virtues. The modern settler in New Zealand would be quite prepared to hear of many Maori proverbs and proverbial sayings in favour of war, cruelty, anger, hate, murder, theft, gluttony, sloth, laziness, lying, duplicity, stratagem, over-reaching and over-bearing conduct, the ill-treatment of women, children, and slaves, and of superstition and omens; but of all such proverbs, as a rule, it may safely be affirmed they are not to be found among those of the Maori people.

There is something in all this which is of far greater moment than appears at first sight; which, I have little doubt, will be duly considered in time to come. The question here naturally arises, Were those many proverbs and proverbial sayings in favour of the good and the useful—real?

What influence had they on the people? Were they ever acted upon? And here, with reference to some of them, I can personally bear testimony; especially to those referring to general industry, to kindness, and to hospitality; to quickness, diligence, and expertness; to endurance, patience, courage, and advice; to good manners, and to good temper;—all these manly and noble qualities I have seen largely practised by the old New Zealander, before Europeans came generally among them. The chief and the lady worked hard and regularly, as well as the plebeian and slave; and as to their hospitality, it was beyond all praise!—not unfrequently giving the whole of their meal (including that of their children), and that, too, in a time of scarcity, and contentedly going without! While ill-manners, ill-temper, and ill-nature,—slander, lying, theft, and disobedience,—idleness, laziness, and begging, gluttony, and anger,—I have not unfrequently heard rebuked with a timely-cutting proverb, and that with good effect. In nearly all those things the Maori has deteriorated fearfully since his close contact with "civilization," and his becoming largely possessed of money!—the "love of which,"* in his case, has truly been "the root of all evil" to the race!

Before, however, that I give you some examples of their proverbs and proverbial sayings, in proof of what I have already said, I would just make two brief remarks concerning proverbs, which alike pertain to proverbs of all countries, *viz.:* (1.) There are some which are wholly untranslateable, or which, when translated literally, lose their meaning. (2.) There are others, again, which from their very brevity yet well-known allusion in their own vernacular, are without any meaning when rendered into a foreign tongue, and can only be made intelligible by a long and perhaps a tedious translation.

The *first* arises from the total want of anything of the peculiar kind whence the simile is drawn in the proverb, being used among the people into whose language the proverb is to be translated. Of what use would such common European sayings as, "As hard as steel," "As heavy as lead," "As precious as gold," be to a people who knew nothing of metals? Or, such allusions as, "As cold as ice," "As white as snow," be to the inhabitants of the tropics? Or, such proverbial sayings as, "Sour grapes," "Great cry, but little wool," "Boy and wolf," be to a people who did not know anything whatever of the things mentioned?

The *second* arises from a similar cause, only here it is the peculiar event—the doing or saying—which is wholly unknown to the people into

* Lest any should say I have Paul's well-known and often-quoted passage in my mind (which I have not), I will give a notable passage to the same effect from the Greek tragedians, 500 B.C.:—"For no such evil institution as money has arisen to men. It lays waste cities; it drives away men from their homes; it seduces and perverts the honest inclinations of mortals to turn to base actions; and it has taught men to learn villanies, and to know the impiety of every deed."—Sophocles: *Antigone.*

whose language the proverb is about to be translated; such as, for instance, the common sayings,—"Coals to Newcastle," "The Greek Kalends," "Davy Jones' locker," "Hobson's choice," "Nelson's signal," etc. Now all such short proverbial sayings as these absolutely lose their pregnant meaning when literally translated, and can only be understood upon being fully explained. A notable instance of all this took place here in New Zealand, some twenty-five years ago. The "Pilgrim's Progress," of John Bunyan, which abounds in homely and useful proverbs and sayings, was translated into the Maori tongue* by order of the Government, and the translator endeavoured to render all such sayings literally! The consequence was he completely spoiled his work,—as the wit, the allusion, or apt turn of such a saying could not possibly be so shown in the translation. He might, however, if he had known them sufficiently well, have supplied, in many places, similar and suitable Maori proverbs in their stead.

And this will be found to be more or less the case in all languages. Still, the rendering of any of the various European proverbs into another European or Western-Asiatic language than its own vernacular is not so difficult, at all events not under the *first* head, because the animals, plants, metals, and things in general, and their uses, are either the same or well known; indeed, it is sometimes a difficult matter to ascertain whence the proverb originally sprang—with the English, the Irish, the Welsh, or the Scotch, or with the British, the French or the German, etc.,—seeing such have ever been alike used by all;† but such a thing can never happen with any Maori proverb, which, however much resembling a European one, must be original;—while, under the *second* head, many of them when translated into another European tongue are pretty well understood. But the very contrary of all this is the case in the endeavour to render our English proverbs into Maori, or the Maori proverbs into English. Hence, it will be observed that by far the larger number of the short, sharp, witty, pungent, and popular ones of the Maori, having no equivalents, cannot be readily rendered into English, and, therefore, must necessarily be omitted by me on this occasion.

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* Though a far better translation of the same work had been made nearly twenty years before, by a skilled Maori scholar; this translation, in MS., I have still by me.

† As, for instance:—"A'are no frien's that speak fair to you" (*S.*), "All are not friends that speak us fair" (*E.*); "As the auld cock craws, the young ane learns" (*S.*), "As the old cock crows, the young one learns" (*E.*); "As the old cock crows, the young bird chirrups" (*I.*). Again, "To carry coals to Newcastle" (*E.*), "To carry saut to Dysart" (*S.*), "To send water to the sea" (*French* and *German*), "To send fir to Norway" (*Dutch*), are all one and the same proverb as to meaning, but which is the original?

Once for all, I may say that, in translating those ancient proverbs and proverbial sayings which I now bring before you, I have studied accuracy before elegance, endeavouring also, at the same time (as far as the differing idioms of the two languages will allow), to preserve much of the manner in which the pregnant thought was originally expressed; such being just as important as the thought itself. In the original, the expressions are arranged for the most part antithetically in distichs, like the Proverbs of Solomon, and, not unfrequently, poetically; and are truly rich in images borrowed from the whole world of Nature.

MAORI PROVERBS, ETC.

I. RELATING TO INDUSTRY.

1. *He tangata momoe, he tangata mangere, ekore e whiwhi ki te taonga.*

    A sleepy-headed lazy fellow will never possess riches.

  Resembling some in the Proverbs of Solomon.

2. *He kai kei aku ringaringa.*

    I can earn my food with my own hands.

  Lit. I have food in my hands; *or* in the use of my hands.

3. *Tama tu, tama ora; tama noho, tama matekai.*

    The working chief (or son) flourishes; the idle chief wants food.

  Lit. Standing chief—living chief; squatting chief—hungry chief.

4. *He kai tangata, he kai titongitongi kaki;*
  He kai na tona ringa, tino kai tino makona noa.

    Food from another is little and stinging to the throat;
    Food of a man's own getting, is plentiful and sweet, and satisfying.

5. *He panehe toki ka tu te tangitangi kai.*

    A little axe well-used brings heaps of food.

This reminds one of the Persian proverb:—"In time the mulberry leaf becomes satin." To have plenty of food for hospitable purposes was the greatest of all things with a New Zealand chief, as nothing raised them and their tribe more in the estimation of all.

6. *Takoto kau ana te whanau o Taane!*

    The forest is felled (for planting), the hard work is done.

  Lit. The children of *Taane* are lying prostrate.—*Taane* being the god of woods and forests, the trees were called his children or offspring.

7. *Tena te ringa tango parahia!*

    Well-done the hand that roots up weeds!

Applied to a steady worker in root-crop plantations. *Parahia*, a low-spreading weed (*Ctenopodium pusillum*), is particularly plentiful at Taupo.

8. *He mate kai e rokohanga, he mate anu ekore e rokohanga.*

    Hunger can be remedied, not so the want of warm clothing.

Lit. Famine can be overtaken, sharp feeling of bitter cold can not be overtaken.

N.B.—Here, bear in mind, that all the garments of the New Zealanders, whether made from their flax fibres, or the skins of their dogs, took them a very long time to make; and the majority were but poorly clothed.

9. *He toa taua, mate taua; he toa piki pari, mate pari; he toa ngaki kai, ma te huhu tena.*

The warrior is killed in war; the fearless scaler of lofty cliffs (in search of sea-fowl) is dashed to pieces; the industrious husbandman lives long and dies peacefully of old age.

Lit. The hero dies in fight; the climber of precipices by a fall; the cultivator of food by worms—*meaning* old age, or gradual decay.

N.B.—This bears out Cook's statement: Vol. III., pp. 460,461. Here is another of similar meaning:—

10. *He toa paheke te toa taua; tena ko te toa mahi kai ekore e paheke.*

The warrior stands on insecure footing (*or* slippery is the fame of the warrior); but the industrious cultivator of land will never slip *or* fall.

11. *Ma pango ma whero ka oti.*

Through chief and slave working together with a will the work will be done.

Lit. By black (and) by red finished.

The slaves and plebeians, naked and unwashed, were black enough; the chiefs used red pigment to anoint themselves.

12. *Maramara nui a Mahi ka riro i a Noho.*

The big chips are hewn off by Worker, but the food is taken and eaten by Looker-on, or Do-nothing, or Idler.

Lit. Worker (has) big chips gone with Squatter!

This proverb is so cleverly constructed as not to give offence to a highly-sensitive race, with whom a cross word, or gesture, or look, respecting food, was quite enough to cause serious disturbance: here, however, so much has to be inferred—"If the cap fits wear it." This is used when men are hard at work hewing timber for a canoe, house, etc.; at which time some are sure to be idly squatting-by looking-on; and when the cooked food for the workmen is brought in baskets, those squatters are often the first to fall-to; and to this, also, no exception can be taken!

13. *Kahore he tarainga tahere i te ara!*

You cannot hew a bird-spear by the way.

Meaning: Without timely preparation you may die for want of food. Birds were formerly speared in great numbers in the woods; but to make a proper bird-spear took a long time, and (to me) was one of the wonders of old!

14. *Ka mate kaainga tahi, ka ora kaainga rua.*

Through having only one cultivation the man dies from want, through two he lives.

Lit. One place death (*or* want), two places life (*or* good living.)

This was carried out fully by the New Zealanders, as to food cultivations, houses, bird-preserves, eel-weirs, fishing-grounds, etc., not only that they might have plenty, but so as to secure some from being carried off by their foes, in time of feuds, often happening.

Another similar proverb ran—

15. *Ka mate whare tahi, ka ora whare rua.*

With one house, want; with two houses, plenty.

The meaning being much the same, only more applicable to the chief having two wives, who, each in her own house, wove garments.

16. *I whea koe i te ngahorotanga o te rau o te kotukutuku?*

Meaning: Where wert thou in the time of work,—*or* of danger?

Lit. Where wert thou in the falling of the leaves of the *kotukutuku?*

This tree (*Fuchsia excorticata*) is the only one in New Zealand which is really deciduous. This proverb may also be used for many other purposes; as,—When in siege or battle your tribe or people were killed, where were you? absent or hiding? *Meaning*, Is it meet for thee to boast, find fault, or speak? At such times it is a very cutting sarcasm; often causing intense feeling.

17. *I hea koe i te tangihanga o te riroriro?*

Where wert thou at the crying of the *riroriro* bird?

The *riroriro* (*Gerygone flaviventris*) cries in the early spring, the season for preparing cultivations for crops; so this proverb is used to a lazy or careless person who is without cultivated food, especially when begging; and it causes great shame. It is not unlike in meaning to the western fable of the Ant and Grasshopper.

18. *Ko te tokanga nui a Noho.*

The peaceful dweller at home has always a thumping big basket of food to eat.

Lit. The big basket of Stay-at-home.

N.B.—Here it should be observed that the dweller at home is merely named *Noho*, = to sit down, to dwell quietly: of course such a one is not supposed to be idle.

19. *He wha tawhara ki uta, he kiko tamure ki tai.*

Inland is the *tawhara* fruit; in the sea, the flesh of the snapper.

Meaning: Sweet food for man is everywhere, in land and water, by exertion.

The *tawhara* is the large sweet sugary flower bract of the *kiekie* (*Freycinetia banksii*), generally found plentifully in the white pine forests,

and formerly eaten abundantly. The *tamure* is the snapper (*Pagrus unicolor*), a common fish on all the coasts.

20. *Whana atu poho ki roto, haere mai taiki ki waho; nohoia te whare, ko te hee tonu.*

Inward goes the pit of the stomach, outward come the ribs (from) persistently sticking in-doors, the greatest of all ills.

This is a highly ludicrous proverb; the joke, or point, being largely increased through the play on the three verbs,—to recede, to come hither, and to squat idly in-doors; or, increased as it is in the passive,—to remain within to support the house! It is used in times of cold and hunger, showing their effects: "Too cold to go out," "Too hungry to remain in-doors without food, yet keeping house!—squatting idly, or doing nothing!"

21. *Te wahie ka waia mo takurua, te kai ka mahia mo tau.*

Firewood is sought for winter, food is laboured after for the year.

Meaning: Be usefully employed.

22. *Te toto o te tangata, he kai; te oranga o te tangata, he whenua.*

The blood of man (is from) food, the sustenance of man (is from) land.

Meaning: Hold to your land, particularly that whence you derive your living.

23. *Taane rou kakahi ka moea; taane moe i roto i te whare kurua te takataka.*

The husband who is dexterous at getting shell-fish in deep water, will find a loving wife; the husband who sleeps idly in the house, will be thumped and knocked about.

This operation of getting shell-fish in *deep* water, both fresh and salt, was generally performed by men with their feet; by which they dislodged the shell-fish, and then got them into proper nets, etc.

II.—In favour of Perseverance, Exertion, etc.

24. *Tohea, ko te tohe i te kai.*

Persevere strenuously, like as you do in eating.

25. *Na te waewae i kimi.*

Obtained by seeking.

Lit. Sought for by the leg.

26. *He iti te toki e rite ana ki te tangata.*

Though the stone-axe be small, it is equal to the man (in clearing the forest, etc.)

27. *He iti hoki te mokoroa, nana i kakati te kahikatea.*

Although the grub is but little, yet it gnaws through the big white pine tree (*Podocarpus dacrydioides*).

28. *Mate kanohi miromiro.*

To be found by the sharp-eyed little bird.

Lit. For the *miromiro's* eye.

Used as a stimulus to a person searching for anything lost. The *miromiro* is the little *Petroica toitoi*, which runs up and down trees peering for minute insects in the cavities in the bark.

29. *He kai iana ta te tou e ho ake?*

Do you think to gain food through inaction?

Lit. Will squatting at home on your posteriors bring you food?

30. *E rua tau ruru; e rua tau wehe; e rua tau mutu; e rua tau kai.*

Two seasons of drought; two seasons of scarcity; two seasons of crop failure; two seasons of plenty.

Meaning: Persevere, keep at it, success will follow.

31. *Tungia te ururua, kia tupu whakaritorito te tupu o te harakeke.*

Set fire to the scrub that the flax plants may shoot forth young evergreen shoots.

Meaning: Clear off the old and bad that the new and good may grow vigorously.

III. Against Idleness, Laziness, Gluttony, etc.

32. *Nga huhu, nga wera, to kai, e mangere!*

This lazy fellow does nothing but roast himself by the fire!

Lit. Burns (and) scalds (are) thy food O lazy-bones!

33. *He kai ko tau e pahure.*

Food is the thing you can get through very well (but work you cannot despatch, *understood*).

34. *Kai hanu, kai hanu, hoki mai ano koe ko to koiwi!*

After going about idly "loafing" (mumping) from place to place (*lit.*, eating scraps!), thou returnest again to thy own proper home!

35. *Hohonu kakii, papaku uaua!*

Deep throat, little sinews (to work)!

N.B.—Here also the adjectives should be noticed, being in direct opposition, and not only so but as here used they have a ludicrous quip, being terms properly and usually applied to water—*Hohonu* = deep: *papaku* = shallow.

This would prove a cutting saying.

Here is a similar one:—

36. *Ka kai kopu, ka iri whata, kei te uaua te kore.*

He fills his belly, he carefully lays up the remainder for himself, but, alas! has no sinews for work!

Here is another :—

37. *To kaha kei te kakii, karapetau tonu!*

Thy strength is in thy throat, for ever swallowing greedily.

38. *He moumou kai ma Te Whataiwi puku ngakengake!*

It's waste of food to give it to big-bellied Store-up-bones.

Two peculiar terms are to be noted here :—1. The figurative *name* given to the person, *Whataiwi*, *i.e.*, one who puts by dry bones (including fishes' heads, etc.) for himself on a platform for storing food ; and, 2. The ludicrous term (not the common one) for big belly, *i.e.*, the loose hanging bag of a large sea-net!

39. *He hiore tahutahu!*

An often singed tail!

Used for an idle fellow. Taken from a lazy dog lying before the fire and getting its tail repeatedly burnt.

N.B. The tail of the ancient Maori dog had very long hair, which was of great value to its master for clothing and ornament, but when singed was useless ; and might therefore be killed for food.

40. *Kei te raumati ka kitea ai e koe te tupu.*

When summer comes you will find it by its sprouts.

Spoken ironically to a person who will not exert himself to find a lost thing, etc.

41. *E noho, tena te au o Rangitaiki hei kawe i a koe.*

Sit on idly, doing nothing, there are the rapid currents of the river Rangitaiki to carry thee along.

Used to a lazy fellow who ceases paddling the canoe.

42. *He huanga ki Matiti, he tama ki Tokerau.*

In the planting season merely a relative ; at harvest time a son (or, eldest son).

43. *He kooanga tangata tahi, he ngahuru puta noa.*

At planting time, helpers come straggling singly ; at harvest, all hands come from everywhere round.

Lit.—to show its terseness—At planting, single-handed ; at harvest, all around.

Here is a similar one, which was a favourite saying of the late chief Te Hapuku :—

44. *Hoa piri ngahuru, taha kee raumati.*

Friends stick to you in harvest, but fall off in summer—the season of scarcity and work.

Very like our English proverbs, "Prosperity makes friends, adversity tries them ;" "The rich man has many friends."

45. *He kakariki kai ata!*

(Like) a little green parrot (which) eats at daybreak!

Spoken of a person who looks to eat on rising before going to work.

46. *He kuukuu tangae nui!*

A pigeon bolts his food.

Used of a greedy fellow, never satisfied.

47. *He kuukuu tangaengae nui; he parera apu paru.*

The pigeon bolts, the duck gobbles up mud and all.

Said of a gluttonous fellow.

48. *He kaakaa kai honihoni!*

A parrot eats leisurely, bit by bit.

Said to a person who eats moderately and slowly.

49. *Ka whakarongo pikari nga taringa.*

(With) ears quick at listening, like young birds in their nests.

Spoken of a fellow always on the look-out for the call to meals.

Here is another of a similar meaning (also one of Te Hapuku's):—

50. *Taringa muhu kai!*

Ears on the *qui vive* for food!

51. *Awhato kai paenga;* and,

Ka mahi te awhato hohoni paenga!

Bravo! great caterpillar eating around the edge of the leaf!

Those *two* proverbs are nearly alike. The *awhato* is the large larva of the moth *Sphinx convolvuli* (or some allied species), which ate the leaves of the *kumara*, or sweet potatoe, in the Maori plantations (beginning at the edges and leaving the mid-veins), and was therefore a most noxious and hateful animal to them. The proverb is used of a greedy person who goes eating from basket to basket at meal times, selecting the best bits. Formerly, the New Zealanders had their cooked food served up in numerous small baskets; they often sat in a circle to eat their food, and always out of doors.

52. *Awhato ngongenga roa!*

Ugly great caterpillar, always slowly nibblin

This is similar to the last two.

53. *Ko Uenuku to korokoro!*

Thy throat is even as Uenuku's.

Applied to a great glutton. This is even stronger in Maori,—"Thy throat is Uenuku." He was a desperate old glutton of very ancient times, who had dwelt at "Hawaiki." Many things are related of him.

54. *Tohu noa ana koe, e Rangikiato, he whata kei te kakii!*

O Rangikiato! what are you after? Laying by food! Verily, a food-store is in thy throat!

Applied to a man who eats more than his share, or who takes away tit-bits from others at meals.

55. *Patua iho, he kaka, ki tahaki tera; a, ka puehuehu, ma tana whaiaro tera.*

He pounds away, lo! a stringy bit,—that's placed alongside (for the visitors); ha! a nice mealy bit, that's for himself or his favourite.

This has reference to the preparation of fern-root for eating; and was used for a sly, selfish, greedy person.

N.B.—There was a great difference in fern-root, of which varieties the Maori had many names. The difference was much the same as in the various kinds of potatoes and of flour with us.

56. *Pikipiki motumotu, ka hokia he whanaunga!*

Constantly returning (at food-time, saying, he does so) because he is a relation!

This proverb is concerning a lazy fellow, a "loafer," who always contrives to drop in at meals, because he is a relation; and is often used in times of scarcity of food, so as to cause those sitting at meat to eat up their victuals quickly. But the whole story is too good to be lost, so I give a translation of it.

"Tama-ki-te-wananga was lighting his fire to roast his food, but the fire did not burn briskly, so he said, 'Bother the fire, it does not kindle well;' and stooping down he blew at it with his breath that it might burn the better. At this very moment Hauokai had come up, and was standing behind his back, but Tama did not know of it; so he kept on blowing away at his fire, saying, between whiles, 'Flame up, blaze away, that thou be not caught by Hauokai.' It came to pass, however, that he (Tama) was indeed thus caught by him while saying those very words. On hearing them, Hauokai called down from behind his back, 'What have you got against me, O Tama-ki-te-wananga?' Then Tama turned round and looked up—alas! there, verily, was Hauokai himself standing looking down on him. For some time Tama kept looking up with vacant surprise, not knowing what to say. At last he said, 'Thy often comings and goings.' Hauokai replied, 'Yes, my returning hither was owing to my relationship.' Then Tama said to Hauokai, 'Just so, and more too; it is thy continually returning hither.' Then it was that Hauokai said to Tama, 'I frequently returned hither, as you have said, through our relationship, but now you and I shall be separate; we shall never again see each other from this time forward; nevertheless, our two spirits (*wairua*) shall meet in the nether world (*reinga*).'* And from that time they never saw each other up to their death."

* There are several items of interest in this old story, but I must pass them by to take up a more modern one. A few years ago, the then Superintendent of the late Auck-

IV. AGAINST SLANDER, LYING, STORY-TELLING, ETC.

57. *He pata ua ki runga, he ngutu tangata ki raro.*

Dropping water wears away the soil, so frequent slander a good name.

Lit. A rain-drop above, a human lip below. Resembling some of Solomon's Proverbs.

58. *He tao rakau e karohia atu ka hemo; te tao kii, werohia mai, tu tonu.*

A thrown wooden spear, if warded off, passes away; the spoken spear, when spoken, wounds deeply.

Another rendering of the same proverb:—

59. *He tao kii ekore e taea te karo, he tao rakau ka taea ano te karo.*

A spoken spear cannot be warded off, a wooden spear can easily be warded.

60. *Ka katokato au i te rau pororua!*

I am going about gathering, bit by bit, the bitter leaves of the sow-thistle.

Meaning: I hear nothing but bitter words against me everywhere.

N.B.—The *pororua* was the old New Zealand indigenous variety (or species) of sow-thistle, which is much more bitter than the introduced variety commonly called *puwha.*

61. *Te whakangungu nei ki nga tara a whai o Araiteuru!*

O for impenetrable armour to oppose against the stings of the sting-rays of Araiteuru!

Used by a chief in defending his own tribe against slander. I believe Araiteuru is a large shoal off the West Coast, near Taranaki; in such places, as also on shoals and mud-flats in harbours, as at Ahuriri, Whangarei, etc., large sting-rays abound.

N.B.—Here again there is much in the very name of that shoal which is lost in translation, *viz.:* Barrier-against-the-western-blast. (Psalm LVII., 4).

62. *Kia eke au ki runga ki te puna o Tinirau!*

I may just as well attempt to climb up and sit on the blow-hole of a whale!

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land Province (Mr. J. Williamson) sought to have an interview with a Maori chief of note on political matters; this, however, the chief would not grant, ending with saying, "You and I shall never meet until we meet in the *reinga.*" This, of course, was made much of. The dreadful bitterness of expression—" never until we meet in hell!—was intensified and dwelt upon shudderingly with much Christian feeling, but all through ignorance on the part of the Christian Europeans. The New Zealander had no such thoughts, and only made use of an old saying, the English having chosen this word (*reinga*) as the equivalent for *hell;* a meaning, however, which it does not possess.

A proverb of deep meaning to a Maori, grounded on legendary lore. Used of slander.

63. *Aweawe ana nga korero i runga o Maunga Piware.*

Reports and talks are ever floating in the air over Mount Piware.

I suspect that this place, "Mount Piware," has a highly figurative meaning:—1. *Pi* and *ware*: *pi* = young downy nestlings, and *ware* = any thing viscous or sticky, as gum, etc. 2. *Maunga* has, besides its common meaning of mountain, the meaning of fast to, adhering to; so that the full meaning may be, reports floating in the air are light and downy, and are easily caught and held by soft viscid surfaces.

Meaning: Don't believe all you hear.

64. *Tangaroa piri whare!*

Tangaroa is hiding in the house.

Tangaroa is one of the great Polynesian gods, and particularly of the sea and fishes; is invisible, and hears all; be careful. "Walls have ears."

65. *Tangaroa pu-kanohi nui!*

Large-eyed Tangaroa can see all you do, or say.

66. *Kei whawhati noa mai te rau o te raataa!*

Don't pluck and fling about to no purpose the blossoms of the *raataa* tree!

The *raataa* tree (*Metrosideros robusta*), produces myriads of *red* flowers; the small parts of these when blown off by the winds fill the air around: so,—Don't become ashamed when your lying is detected.

67. *Ko Maui whare kino!*

Yes, Maui with the evil house! or, Just like Maui of the house of ill-fame!

Schemes and cunning stratagems were planned in Maui's house, or by Maui wherever staying; he was truly the coming deviser of schemes; in this respect much after the fashion of Mercury, the son of Maia;* and of Proteus.

68. *Ko Maui tini hanga!*

Yes, Maui of many devices!

These last two proverbs were often used in speaking of a scheming, cunning person.

69. *Ko korua pea ko Tama-arero i haere tahi mai?*

Perhaps thou and False-tongue† travelled hither together?

70. *Korua pea ko Te Arahori, i haere tahi mai?*

Perhaps thou and False-road came here together?

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* Sophocles; *Philoctetes.*—Aristophanes; *Plutus.*—Horace; *Odes*, lib. I., 10.

† Son-of-the-tongue, *or*, Master-of-the-tongue, would be more literal, but I have given the meaning.

71. *I haere mai pea koe i te kaainga i a Te Arahori?*

Perhaps thou camest hither from the village of Mr. False-way?

72. *Korua pea ko Te Tangokorero i haere tahi mai?*

Perhaps thou and Take-up-talk travelled hither together?

73. *Na Tangokorero pea koe i tono mai ki konei?*

Perhaps thou wert sent hither by Take-up-talk?

Those last five proverbs are very nearly alike in meaning, though used by different tribes. They were made use of when visitors should arrive bringing strange tales, or slanderous ones. I bring them here together to show how largely the ancient New Zealanders dealt with fictitious and figurative characters, to whom they gave highly appropriate names, just as Bunyan, already mentioned.

74. *Ka mahi te tamariki wawahi taahaa!*

Bravo! children, smashing your (mothers') calabashes!

This saying is often applied to a man who is defaming his own relations, or tribe.

V. Against Trusting to Promises, Appearances, etc.

75. *Nga korero o era rangi, mahue noa ake!*

Promises of other days, wholly left behind!

"Never trust to fine promises."

76. *He marama koia kia hoki rua ki Taitai?*

If indeed thou wert like the moon to return a second time to its place of shining?

Lit. A moon indeed! to return twice to one place (or to Taitai = name of place)?

Said to a person who promises to give you something at the next time of meeting.

77. *Poroaki tutata, whakahoro ki tau kee!*

Last words at parting stand close at hand, deferred by slips to another year!

Said of a person too ready in promising.

N.B.—The word "*whakahoro*"—which I have rendered deferred by slips—is here very expressive; it means to fall by degrees, or to slip, slide, or crumble down, as clayey cliffs, etc.; or to be levelled, as mounds, dykes, etc.

78. *Hohoro i aku ngutu, e mau ana te tinana.*

My lips were quick (to move), the body being fixed.

Meaning: Promises were quickly made, but the body is slow to perform.

N.B.—"Body," with the old Maoris, meant more than with us; *viz.*, the whole man, the entirety, the substance, as against the mere lips. Just

as we might speak of the body of an oak in comparison with two of its branchlets.

"My tongue hath sworn, my mind is still unsworn."—EURIP.; *Hippolytus.*

79. *Haere ana a Manawareka, noho ana a Manawakawa.*

Well-pleased goes off, Bitter-mind remains behind!

Meaning: He who has got what he wanted goes away rejoicing; while he who has given without any return gift, trusting to the others' promises, endures the pangs of disappointment and regret.

80. *Tee whai patootoo a Rauporoa!*

Long-Bulrush did not strike loudly and repeatedly (so as to be heard)! *or,* Long-Bulrush gains nothing by his repeated attempts at hitting!

This proverb is used by, or for, a person who returns without that for which he went. It is one of deep meaning to an *old* Maori (though little understood by the present younger ones), and always evokes a laugh; but requires a little explanation.

The *Raupo* plant (= Bulrush, *Typha angustifolia*), which is here figuratively personified, grows in watery places and in the water; the tips of its long narrow numerous leaves are always agitated with the least breeze, and are naturally carried by the same in one direction before the wind; hence, they invariably keep the same distance from each other, or, if they clash, their striking is not heard, and is productive of no result. Moreover, as the longest plants grow only in the deeper water, the saying may also have a latent reference to the greater difficulty in gathering the flowering spikes from such tall plants; for, in the summer season, parties went among the *Raupo* specially to gather the dense heads of flowers for the purpose of collecting their pollen, when only a smaller quantity could be obtained from the over-long plants, owing to their extra height above and to the greater depth of water below, etc., though attended with much more labour. This pollen, in its raw state, closely resembled our ground table-mustard; it was made into a light kind of yellow cake, and baked. It was sweetish to the taste, and not wholly unlike London gingerbread. Thirty years ago, specimens of it, both raw and baked, were sent to the Museum, at Kew. I have seen it collected in buckets-full.

81. *Hei te tau koroii!* and, *Hei te tau ki tua!*

Put off till the season in which the white pine tree bears its fruit! (which is not, however, every year); *and,* At the season yet to come.

82. *He iramutu tu kee mai i tarawahi o te awa.*

A nephew stands carelessly (or, without regard) on the opposite side of the river.

Meaning: He is not to be depended on in times of extremity, etc., like a son.

I take it, however, that this "nephew" is the son of a brother, not the son of a sister.

83. *He pai rangitahi!*

A one day's beauty; a short-lived pleasure.

Sometimes used of a girl's countenance.

Meaning, also: After a fine day, a storm follows; after a great feast, a famine, etc.

84. *He pai tangata ekore e reia; he kino wahine ka reia.*

A handsome man is not always eagerly sought after; an ugly woman is eagerly sought for—*or*, has plenty of lovers.

Here it should be remembered, that with the New Zealanders the women always began the courting.

85. *He pai kanohi, he maene kiri, he ra te kai ma tona poho; waihoki, he pai kupu kau.*

Pretty face, smooth skin, loves to bask idly in the sun; therefore the beauty consists in words only. ("Prettiness dies quickly").

This is plain enough; but, in the next, we have just the opposite.

86. *He pai kai ekore e roa te tirohanga; he pai kanohi e roa te tirohanga!*

Good and pleasant food is not long looked at; a good-looking face is long observed.

Meaning: Looked on with satisfaction and delight.

VI.—AGAINST A BOASTER, ETC.

87. *He nui to ngaromanga, he iti te putanga.*

Long thy absence, little seen (with thee) on return.

88. *E wha o ringaringa, e wha o waewae!*

Thou hast four hands and four legs!

A word said quietly to a boasting fellow.

89. *He kaakaa waha nui!*

A noisy-mouthed parrot!

Applied to a chatterer, or boasting person.

90. *Me ho mai nga hau o Rirapa ki uta.*

Let the exploits of Rirapa be brought to land.

91. *Kei uta nga hau o Rirapa te tu ai.*

'Tis on shore that the fine doings of Rirapa are seen.

Both used of a lazy, hulking fellow, who is lazy in a fishing-canoe at sea, etc.

92. *Whaka-Ruaputahanga i a koe!*

Thou art making thyself appear as big as the great lady chief of old Ruaputahanga!

Said to a boaster.

Here again, no doubt, is a figurative name; or a secondary name, often added on account of qualities, doings, etc.; Ruaputahanga meaning a store whence goods, etc., were always being issued. The liberal person was always liked and immortalized.

93. *Toku toa he toa rangatira.*

My courage is that of a chief; *or*, my courage is derived from my ancestors.

Said, but rarely, to a mushroom-man of to-day, who boasts of himself or his doings.

Here it should be borne in mind that a chief of to-day is the descendant of ancient chiefs.

94. *Ko nga rangatira a te tau titoki!*

Chiefs of the *titoki* year!

This needs explanation. The *titoki*, or *titongi* tree (*Alectryon excelsum*), from the fruit of which the natives formerly extracted an oil for anointing the hair and persons of their chiefs, only bore fruit plentifully (according to them) every fourth year; so that, in that year, all hands could use the oil and a little red pigment, and thus, for once, look like a chief without being so.

(A daw in borrowed plumes.)

95. *Tiketike ao, papaku po!*

A tall pinnacle by daylight, shallow water by night.

Lit. Lofty day, shallow night.

Meaning: Valiant and boasting, when the sun is shining and all is well and no danger near; but in the darkness and dread, low enough.

96. *Tiketike ngahuru, hakahaka raumati!*

Tall at harvest, low at planting season!

Meaning: He boasts enough in the autumn when there is plenty of food and little to do; but in the wearisome and heavy working spring season he is not to be seen.

97. *Ko wai hoki koia te wahine pai rawa? Te wehenga atu ano i a Muturangi!*

Who, indeed, now is the beautiful woman? All that ceased for ever with the last great lady (*i.e.*, when she died).

This saying is used when a woman is vain of herself; or, when persons boast of the good old times, when better, or handsomer females lived.

The ancient beauty's name, *Muturangi*, means,—the last of the great lady chieftainesses. *Rangi* (= sky, heaven) is an ancient name for a principal chief, whether male or female,—from *Rangi*, the first parent or producer of man; and was also used by way of high title, or address. I have no doubt, however, of its here having a highly figurative meaning, like other proper names in many of their proverbs.

VII.—Against Inhospitality.

98. *He kuukuu ki te kaainga, he kaakaa ki te haere.*

A pigeon at home, a parrot abroad.

The New Zealand pigeon is a silent bird; the parrot is a noisy screamer. The pigeon remains quietly sitting on the high trees; the parrot flies about, making the forest resound with its loud cries.

This proverb is applied to an inhospitable chief; he does not raise the cheerful inspiriting shout of "Welcome!" to travellers nearing his village; but, when he travels, then, on approaching any place, he sounds his trumpet to get food prepared, and afterwards finds fault with the victuals given him.

99. *E riri Kai-po, ka haere Kai-ao.*

When Eat-by-night is angry, Eat-by-day leaves.

Meaning: If the illiberal mean chief be angry (shown by withholding food and welcome), the liberal generous men continue on their journey.

It was considered a very great insult for a travelling party to pass by a *pa* or village without calling. *Kai-po* is the common term for a mean selfish person.

100. *Kei kai i te ketekete.*

Lest there be nothing to eat but vain regrets.

Meaning: Bad for both sides—the visitors and visited—to have only excuses for food.

This proverb was sometimes used by a chief as a warning to his tribe, when expecting visitors.

101. *He kotuku kai-whakaata.*

The white crane eats leisurely, after viewing his food and his own shadow in the still water.

This is said of a chief who looks after due preparations being made for his expected visitors; also, of one who quietly and courteously awaits the arrival and sitting of others to their repast before he eats his own food.

VIII.—Relating to Hidden Thoughts.

102. *He kokonga whare e kitea.*

The dark corner of a house can be seen and searched;—(*understood*, to complete the meaning) but not the heart of man.

103. *He taanga kakaho ka kitea e te kanohi; tena ko te taanga ngakau ekore e kitea.*

A mark, or knot (or placing), of a reed can be seen with the eye, but that of the heart can not be seen.

104. *He ta kakaho e kitea, ko te ta o te ngakau ekore e kitea.*

A knot, joint, or mark, on the cutting-grass reed is seen, but the mark or knot (heaving or thought) of the heart is not seen.

I have often heard these last two proverbs used. They fall with bitter effect on the guilty person, often causing deep shame, as the New Zealanders abominated slander. The reference in both is to the *kakaho* reeds or flower-stalks, (cutting-grass = *Arundo conspicua*), formerly used for the inner walls and ceilings of a chief's house; these were sometimes partly coloured black in a kind of pattern of scroll-work, and when regularly laid side by side had a pleasing effect; any irregularity, however, in pattern or in laying, was speedily detected by the practised eye of the Maori; hence the proverb.

105. *He nui pohue toro ra raro.*

The convolvulus (roots are) many and spread below (the soil):—*supply*, just as the secret thoughts of men's hearts are hidden within.

106. *He tiitii rere ao ka kitea, he tiitii rere po ekore e kitea.*

The petrel which flies by day is seen; the petrel which flies by night is not seen.

One species of petrel always flies back to its mountain home from the ocean very late in the evening; I have very often heard its cry, but never saw it on the wing.

This proverb is said of men's thoughts; also of night-attacks from the enemy.

107. *Ko to kai waewae te tuku mai ki au, kia huaina atu, e arotau ana mai.*

Thou allowest thy feet (or thy footsteps) to come hitherwards to me, that it may be said abroad, thou lovest to come hither.

Often said by a woman who doubts the affection of her lover; also by the people of a village who doubt the professions of a visitor.

108. *Katahi ka auraki mai ki te whanau a te mangumangu kikino, i te aitanga a Punga i a au e!*

How strange! to struggle to hasten hither of thy own accord to the offspring of the black and ugly, to me the begotten of Punga!

Punga is said to be the father or progenitor of all the ugly and deformed fish, as sharks and rays, and also of lizards.

This proverb is applied by a man to a woman who had deserted him as her lover, but who returns to him again.

IX. Respecting Caution, etc.

109. *Ehia motunga o te weka i te mahanga?*

How often does the wood-hen break away from the snare?

Meaning: Take care, you will be caught at last.

110. *Ka hoki ranei te weka i motu ki te mahanga?*

Will the escaped wood-hen indeed return to the snare?

Meaning: "Once bit, twice shy."

111. *Hoki atu i kona, ko te manu i motu i te mahanga ekore e taea te whai.*

Go back from where you are, it is useless pursuing the bird escaped from the snare.

Meaning: It is useless to attempt to take me in again. Said to have been used in ancient times by a lady who ran away from her husband; he pursued her to bring her back, and she got round a headland at low-water; on his reaching the place, the tide was breaking against the base of the cliffs, when she called to him from the top using those words, which have since passed into a proverb.

112. *He pureirei whakamatuatanga.*

A faithful fatherly tuft of rushes.

This is said of a good solid tuft of rushes in a swamp, which, in crossing the swamp, you stand on to rest awhile, and to look around before you take the next step. A word of caution for many things. "Look before you leap."

113. *Ka tuwhaina te huware ki te whenua, e hoki atu ranei ki tou waha?*

When the spittle is spit out on the ground, will it return to thy mouth again?

Meaning: (much as the last), "Look before you leap."

114. *Kia mau koe ki te kupu a tou matua.*

Hold fast to the advice of thy father (or guardian).

A word of caution often given to the young,—as the dying advice, or teachings of the departed, were always strongly inculcated.

115. *Kia whakatupu tangata, kaua hei tutu.*

Show yourself (*lit.*, be growing up) a true man; never be disobedient.

Often said to the young. (I. Cor. xvi., 13).

116. *Kapo atu koe i te kai i nga ringaringa o nga pakeke, a e taea ranei e koe te whai i nga turanga o tupuna?*

Thou snatchest food roughly from the hands of the elders, and dost thou think thou wilt be able to follow in the steps of thy ancestors?

Applied to a chief's child, on his snatching food, or anything, from the hands of aged persons.

117. *Ata! ina te kakii ka taretare noa; ka maaro tonu nga uaua o te kakii!*

How disgusting! to see the neck turning from side to side; and the sinews of the neck strained to the utmost!

Said of a person looking over the other baskets of cooked food set before a party, and coveting what is placed before his neighbours or companions. The peculiar terms used are those which refer to a bird on the look-out up in a tree.

118. *Kaore a te rakau whakaaro, kei te tohunga te whakaaro.*

The wood has no thoughts, such only belong to its carver, or designer.

119. *Tirohia, he moko.*

Examine well a tattooed countenance! (*Meaning:* A nobleman.)

Said by a man to another who stares rudely at him.

120. *He whakatau karanga, tino taka iho a Te Kaahu.*

At the very first attempt to make the call (to dinner), down rushes Te Kaahu.

Applied to a person who jumps at an invitation which was scarcely really meant. The person mentioned figuratively by name, Te Kaahu, is, translated literally, the Hawk.

121. *Mate wareware te uri o Kaitoa; takoto ana te paki ki tua.*

Foolishly died the offspring of Recklessness, the fine weather was ready close at hand.

122. *Mate papakore te uri o Kaitoa.*

The offspring of Rashness died heedlessly.

These last two proverbs have the same meaning; the reference is to those who went hastily to sea in their canoe when a gale was coming on, and all miserably perished; fine weather, too, being near.

Meaning: Be prudent; don't act rashly.

123. *Kei mau ki te pou pai, he pou e eketia e te kiore; tena ko te pou kino, ekore e eketia e te kiore.*

Do not select a fine nice post (for your storehouse), as that kind of post will be climbed up to the top by the rat, but the ugly post will not be so ascended by the rat.

This is advice from a father to his son about taking a wife (which has become a proverb)—*meaning:* Do not seek so much for a handsome person, who may cause you trouble, for you may be better off and dwell quieter with a plain one.

124. *He pirau kai ma te arero e kape.*

The tongue soon detects and rejects (a bit of) rotten or bitter food.

Meaning: Any evil thing may be quickly found out and thrown aside.

125. *Honoa te pito ora ki te pito mate.*

Join the living end to the weak one.

Used sometimes for raising a weak or impoverished chief or tribe, by alliance or marriage with a stronger one.

An allusion is here made to the ends of *kumara*, or sweet potatoes; in planting, they make use of the sprouting end of the root as seed, and so, sometimes, place two such ends in one little hillock to make sure of plants.

126. *Honoa te pito mata ki te pito maoa.*

Eat together (*lit.*, join) the underdone end with the nicely-cooked end (of the sweet potatoes, *understood*).

Meaning: Don't be too nice.

127. *Kai mata whiwhia, maoa riro kee!*

Food underdone (is) your own (*lit.*, possessed), fully-cooked goes (with others).

Meaning: Be quick at your cooking and eating, or visitors may eat it for you.

128. *Tunu huruhuru, kei wawe tu ana a Puwhakaoho.*

Roast (your bird) with its feathers on; (or your rat) with its fur, lest you be suddenly surprised by an unwelcome visitor.—Here figuratively named Startling-trumpet.

The meaning of this is the same as the last.

129. *Kakariki tunua, kakariki otaina.*

Eat up the green parrots whether roasted or raw.

Meaning: Be not over nice; as a party travelling in the woods, or going to fight, has no time for much cooking.

130. *Hohoro te kai ma tatou; akuenei tu ana Rae-roa, noho ana Rae-poto!*

Hasten the food for us; soon (the) Long-foreheads (will be) standing (here, when) Short-foreheads (will have to) sit down.

Raeroa, or Long-forehead, is a name for chiefs; while *Raepoto*, or Short-forehead, is a name for the common men. I suspect this arose from the old manner of dressing their hair,* in which that of the male chiefs was drawn up tightly in front and secured at the top by a knot, or band; while that of the lower people hung loosely down. The New Zealanders, always a hard-working people, were quite alive to the English proverb of "Quick at meat, quick at work."

X. Against Making Much of Small Matters.

131. *Kei maaku toku.*

Do not wet my garment.

Lit. Let not mine be wetted: the passive being the more genteel, or mannerly, way of expressing it. The whole saying is, perhaps, worthy of notice:—

Kei maaku toku kakahu! A, maaku noa atu? Kapaa, he wera ite ahi, ka kino; tena, he maaku i te wai,—horahia atu ki te ra kua maroke!—

Don't wet my garment! And yet, if it were wet, what then? But if, indeed, it were burnt by fire, that would be bad; as it is, however, merely wet with a little water,—just spread it in the sun, and it is dry again in no time!

Meaning: Don't complain of trifles.

In the olden time, when no chief ever raised a cup, or calabash, of water to his lips to drink, but slaves went round giving them water, by pouring

* *Vide* plates, 13, 55, etc., in Cook; and in Parkinson, 15, 16, 17, 21.

it out of a guggling calabash into the palm of the chief's hand, held beneath his under-lip,—no doubt it was a ticklish matter to give drink to all, sitting closely together, without wetting their scanty clothing. And so, this story, or saying, was invented to ease the poor slave!

Here is another, and a good one, having the same meaning:—

132. *Tineia te ahi! auahi tahi!*

Put out the fire! there's nothing but smoke!

A sentence, or exclamation, *often* made, as I have too painfully experienced in their close houses without a chimney! But, again, let us have the whole story:—

Tineia te ahi! auahi tahi! Ha! he au uta! Kapaa, ko te au ki Katikati, ae.

Put out the fire! there's nothing but smoke! Exactly so! but it is smoke on land! If now, it were the whirling currents at Katikati,—then, indeed, you would have something to complain of.

One of the peculiarities of this sentence is the play upon words, which is lost in the translation. The same word (*au*) is used for smoke as for a strong current or rapid; it is also used for the gall of the liver of any animal; and frequently for anything very bitter. *Ergo;* Just as smoke is to the eyes, so is gall to the taste, and strong fear or dread to the heart, or inner feelings. Moreover, the name of the place with the fearful rapids is *Katikati* = to bite sharply and quickly; to sting like nettles, thorns, etc.; to draw and pain, as a blister, mustard-plaster, or living "Portuguese man-of-war"—one of the stinging *Medusæ.*

133. *Ka uia tonutia e koe, ka roa tonu te ara; ka kore koe e uiui, ka poto te ara.*

If (the length of the road) be continually enquired after by thee, then it will prove very long; but if thou wilt not keep asking, then it will be short.

This speaks for itself. It is just the same with us.

134. *Pipitori nga kanohi; koko taia nga waewae; whenua i mamao, tenei rawa.*

With sharp bird's eyes and quick moving feet, land at a distance will soon be gained.

Similar in meaning to the last—a word of comfort to young, or new travellers.

135. *Imua, ata haere; i muri, whatiwhati waewae.*

Those who leave early on a journey travel leisurely; those who leave late, and have to overtake the others, hurt their feet.

Lit. Foremost, travel gently; hindmost, break legs.

136. *Kia noho i taku kotore; kia ngenge te pakihiwi.*

Be thou sitting behind my back (*lit.*, anus), and let thy shoulder become weary.

A saying for paddling in a canoe.

Meaning: All work has unpleasantnesses. "No gains without pains."

137. *He manga-a-wai koia, kia kore e whitikia?*

Is it indeed a big river, that cannot be crossed.

A saying often used, *meaning:* It is as nothing, why make such a fuss about it.

XI. Against beginning War, etc.

138. *He kai kora nui te riri!*

War (is like) a devouring fire kindled by a spark. (James, iii. 5.)

139. *Ka tahuna te ururua ki te ahi, ekore e tumau tonu ki te wahi i tahuna atu ai; kaore, ka kaa katoa te parae.*

When the tangled fern and shrubs are fired, (the fire) will not always be fixed in the place of firing, but will burn up the whole open country.

Meaning: The sure extension of warfare.

140. *Kei uta te pakanga, kei tai te whiunga.*

Though the fighting is begun inland, the spreading and finishing will be at the sea, or sea-side.

Lit. Inland the fighting, at sea-side the flinging,

Meaning: In war the innocent suffer for the guilty.

141. *E tae koutou ki uta, kei mau ki tai ki Tu, puhia he angina! e mau ki tai ki Noho, ma te huhu e popo, e hanehane.*

When you reach land, do not hold with the fighting-side, or you will be blown away as thin air; but hold with the side of Peace, that you may live long and die naturally.

Lit. When you land, do not hold to the standing-side (or the side of *Tu* = god of war), blown away, thin air; but hold to the sitting (or quietly-dwelling) side, for the worms gradual decay and skin disease.

This is a difficult sentence to render into English; but it is well worth preserving on account of its alleged antiquity. It is said, in their legends, to be the parting advice of an old chief, at "Hawaiki," named Houmaitawhiti, to his sons, on their leaving "Hawaiki" for New Zealand. Of course, the meaning is, "Hold fast to peace."

N.B.—Note the opposition in the words *Tu* and *Noho; Tu*, standing, and restlessness = War; *Noho*, sitting, and settledness = Peace.

142. *E horo ranei i a koe te tau o Rongomaitakupe?*

Canst thou level the rocky ridge (or shoal) of Rongomaitakupe?

Meaning: Canst thou cause peace when war begins?

Rongomaitakupe is an extensive shoal or ridge of rocks, on which a terrible surf is always breaking. Here one is reminded of similar questions in the ancient Eastern book of Job, respecting the taming of Behemoth and Leviathan.

143. *He ika kai ake i raro.*

A fish eats upwards from below.

The fish which you have caught, and is lying dead in your canoe, commenced nibbling from below in the depths of sea, and out of sight.

Meaning: From trifling disputes bloody wars arise, ending in the death of chiefs;—often poetically termed *ika* = fish.

144. *Ko Nukutaumatangi, ko te hara; waiho te raru mo Rupe.*

Nukutaumatangi was the cause of all the trouble; but Rupe got caught and punished for it.

Said to a person who gets others punished for his evil doings.

Here, also, from the names, there may be more of meaning than appears at first sight:—Nukutaumatangi = off to windy ridge; Rupe, the opposite (being also a name for their proverbially quiet and harmless pigeon).

145. *Kaua e hinga mai ki runga i a au, kapaa iana he urunga oneone, ko te urunga mau tonu.*

Don't lean on me (as a pillow), if indeed (I were as a) pillow of earth, that would remain firm.

Meaning: Don't look to me for help.

146. *Ka tae ki Weriweri, he tohe rara, tona otinga.*

When (two) arrive at (the place called) Angry-dispute, the end is actual strife. (Angry-dispute is here spoken of as a place).

Meaning: Keep your temper.

147. *Kaati ra to penei, ka tae kau taaua ki Weriweri.*

Leave off thy (saying, *or* doing) thus, for you and I have fully come to Angry-dispute.

A timely word of warning; similar to the last.

148. *He tohe taau ki Kaiwere?*

Art thou striving to reach *Kaiwere?*

Meaning: Provoke me a little longer and you will be hurt.

149. *Ka karanga Taiha, kia apititutia, kia whana te hingahinga nga tupapaku; ka karanga Maero, E, kawhakina tetahi momo ki te kaainga.*

Taiha cried, Close ranks with the enemy standing, that their slain bodies may early fall! Maero cried, Better let some retreat as posterity for our possessions!

Meaning: Discretion better than rashness.

"The better part of valour is discretion."—*Shakspeare.*

150. *Ka riri Taiha, ka kata Maero.*

When Taiha (is) angry, Maero laughs (*or* is merry).

Meaning: Keep your temper.

151. *I paia koia te reinga?*

Is the entrance to the lower world barred (*or* closed)?*

Said to one desirous of war.

152. *He iti tangata e tupu; he iti toki, e iti tonu iho.*

A little human-being will grow; a little stone-axe always continues little.

N.B.—An axe (though only of stone) was formerly among the most valuable of their goods. Cook says,† he could not get the New Zealanders to sell him any of their stone axes, not for anything he had in his ship.

Meaning: A man is of more value than any property.

XII. Concerning Conduct in time of War, etc.

153. *I nga ra o te pai, hei pai; i nga ra o te kino, hei kino.*

In times of peace dwell peacefully; in times of war be brave.

Or, In the good days be good; in the evil days be evil.

Here, again, is a double play on words which possess much meaning.

"In peace he was the gale of spring,
In war the mountain storm."

154. *Ruia taitea, kia tu ko taikaka anake.*

Shake off the sap-wood, and let the hard heart-wood only stand.

In a *totara* tree (*Podocarpus totara*) the *taitea* is the outer, white or sap-wood, which soon decays, and near the centre is the *taikaka* or hardest wood.

Meaning: Let the common people and children stay at home, and the warriors only go to fight.

155. *Rangitihi upoko i takaia ki te akatea.*

Rangitihi's head was bound up with the white-flowering creeper (*Metrosideros albiflora*).

This hero of old, when his skull was split with his enemy's club, had it bound up with this creeping shrub, and, although his men had retreated, led them on again to battle, and gained the day.

Meaning: The truly brave man never despairs.

156. *Ko te upoko i takaia ki te akatea.*

The head which was bound with the white-flowering creeper.

Used for a brave warrior:—He binds up his head, or wounds, and fights away.

A proverb similar to the last, and from the same incident.

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* So Virgil:

—— "facilis descensus Averno;
Noctes atque dies patet atri janua Ditis."—*Æn.*, lib. vi.

† First Voyage, Vol. III., p. 464.

157. *Ka mahi te tawa uho ki te riri!*

Well done *tawa*-kernel fighting away!

158. *He tawa para! he whati kau taana!*

A *tawa* pulp! he only runs away!

These two proverbs I have taken together, on account of their simile. The *tawa* tree (*Nosodaphne tawa*) bears a large purple fruit, in which there is a single stone or kernel, not wholly unlike that of the *date;* this is exceedingly hard, and cannot easily be broken; the pulp or flesh of the fruit is very soft when fully ripe; hence, from the *one* fruit, the comparison is drawn of the hero and the coward.

159. *Te waka pukatea; te waka kohekohe.*

The canoe (made of the) *pukatea* tree; the canoe (made of the) *kohekohe* tree.

The wood of those trees is alike soft, and won't last long in the water; besides canoes made of them are both heavy (when water-logged) and slow. *Pukatea* = *Atherosperma novæ-zelandiæ; Kohekohe* = *Dysoxylum spectabile.*

This proverb is used of cowards.

160. *He hiore hume!* and, *He whiore hume tenei tangata!*

Both terms derived from dogs, which clap their tails between their legs and sneak away. Used also of cowards.

161. *Titiro to mata ki a Rehua, ki te mata kihai i kamo.*

Look up with thine eyes at the planet Mars (or Jupiter), at the eye which never twinkles.

Meaning; Never allow your eyes to wink when face to face in hand-to-hand combat.

162. *He koura koia kia whero wawe?*

(Art thou) indeed a crawfish, to turn red, the moment (thou art) thrown on the fire?

Said to a foe in hand-to-hand encounter, who boasts you have not yet hurt him.

163. *Tini whetu, e iti te pokeao.*

The stars are many, but a little black cloud hides them.

Meaning: A small party of determined warriors may beat a large number.

164. *Ma wai e rou ake te whetu o te rangi ka taka kei raro?*

Who can reach (or scrape) with a crooked stick the stars of heaven that they should fall below?

Meaning: Can you take captive a powerful chief?

165. *He mate i te marama.*

The moon dies, *or*, it is of the nature of the moon to wane or die, (and returns again, *understood*).

Meaning: Not so, however, with you; so beware of rashness.

166. *Kia mate a Ururoa! kei mate Tarakihi.*

Let us die fighting bravely, as the fierce shark, *Ururoa*, struggling to the last! and not die quietly like the fish *Tarakihi* (*Cheilodactylus macropterus*).

167. *He pokeke Uenuku i tu ai.*

By means of the dark cloud the rainbow is seen to advantage brightly.

Meaning: A chief looks well at the head of a large tribe.*

168. *Me te koteo mau kupenga!*

Like the post in the sea to which the ends of the net are fixed to keep it open.

Said of an able chief whose influence keeps his tribe together, so that their enemies are finally enclosed and taken, as fish in a net.

169. *E moe ana te mata hii tuna, e ara ana te mata hii taua.*

Sleeping are the eyes of the eel-fisher; wakeful are the eyes of the war-fisher.

Meaning: That the eyes and thoughts of the fisherman enjoy peaceful rest at nights, and he even nods between his bites when fishing; but those of the planner and conductor of battles know no rest.

170. *Tatai korero i ngaro; tatai korero e rangona.*

Concerted schemes are hidden = come to nothing; concerted plans are heard = carried out.

Meaning: Only those schemes which are agreeable to the tribe will be attended to.

171. *Hinga iho, tomo atu te pa.*

(The enemy), falling (before you), enter the fort.

Meaning: Follow up quickly an advantage; *i.e.*, having defeated the enemy in the open, storm their village.

172. *Te koura unuhanga a Tama.*

The crayfish which was pulled out (of its hole) after long pulling and working by Tama.

Tama is said to be one of the first who found out the plan of dislodging crawfish from their holes and using them as food.

Meaning: Not easy to dislodge a warrior from his strong-hold, but got out at last!

173. *Turaungatao e, E pewhea ana te mamae? Taaria iho. Kihai he hanga-hanga ake te kai a Turaungatao!*

O Stand-against-a-hundred-spears, what kind of pain (is caused by a wound in battle)? Wait a while. It was not long (before he knew) the food of Stand-against-a-hundred-spears.

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* *Vide* Prov. No. 11, *ante*.

This question is supposed to be put by a young man before the battle begins to an old warrior, and half slightingly. After the battle is over, and the young fellow wounded, the veteran says to him, "Ah! You thought that what I had had so much of (*my food*) was a trifle, did you? What think you now? "He jests at scars that never felt a wound."—*Shakspeare.*

174. *E! ko te matakahi maire!*

Lo! the iron-wood wedge!

Used of a warrior.

Meaning; He separates the enemy before him, as the wedge of the hard *Maire* wood (*Santalum cunninghamii**) splits up a log.

175. *E tia! me te wheke e pupuru ana!*

Though stabbed through (with my spear), he holds on (to it) like a cuttle-fish with its arms and suckers.

Said by a warrior of his hand-spear in fight.

Another saying of similar meaning:—

176. *Me te mea kei te paru e titi ana!*

As difficult to pull my spear back out of his body as if I had stuck it into sticky holding mud.

177. *Waiho i te toka tu moana!*

Stand firm and compact as the surf-beaten rock in the ocean!

Used by a chief in battle.

178. *Waiho kia oroia, he whati toki nui.*

Just leave the big stone axe to be re-sharpened, its edge is merely chipped a bit.

Meaning: Though some of the braves of our tribe are killed, the remnant, including the chief, will fight the more fiercely.

179. *Ekore e ngaro, he takere waka nui.*

The hull of a large canoe cannot be hidden.

Meaning: Although we have lost many in battle, we shall not become extinct; our tribe is numerous.

180. *He puia taro nui, he ngata taniwha rau, ekore e ngaro.*

A cluster of flourishing *Taro* plants (*Colocasia antiquorum*), a hundred devouring slugs, or leeches, cannot be extirpated = It is difficult to destroy them all. So with a large tribe.

181. *Kore te hoe, kore te taataa.*

Alas! without paddles and baler!

A canoe in this state must be lost. Applied to a tribe in a helpless state.

182. *He pukepuke maunga, e pikitia e te tangata; he pukepuke moana, e ekeina e te waka; he pukepuke tangata, ekore e pikitia e te tangata.*

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* But, at the south parts of the North Island, *Maire* is the Maori name of the *Olea cunninghamii*,

The mountain's summit can be climbed by man; the waves of the ocean can be topped by a canoe; the human mount cannot be scaled by man.

Meaning: If he had sought shelter on the mountain, or at sea, we could have followed him; but being sheltered by a great chief, we cannot follow him there.

N.B.—Note the play on the three mounts—*pukepuke;* which are wholly lost in translation.

XIII. Miscellaneous.

183. *I motu mai i whea? te rimu o te moana.*

Whence was the drifting sea-weed torn?

Sometimes used of a stranger.

184. *He rimu pae noa!*

A sea-weed driven about!

Used by a wanderer concerning himself. I have known this saying used in a very melancholy way by a young man, a lover, when discarded by his love, and he travelling from place to place to forget his grief. It struck me as being very poetical.

185. *I taia to moko ki te aha?*

To what purpose was your face tattooed?

A cutting sarcasm to a finely tattooed man, when he acts cowardly or meanly. As only nobles and chiefs were tattooed.

186. *Kapaa ianei he matua whare e hinga ana, ka hangaa ano, kua oti; ano ko te marama kua ngaro, kua ara ano.*

If indeed your father had fallen like a house, then he could be raised again and finished anew; or if he were as the moon and died, then he would return again.

This saying was too often used by the watchers around a dead chief to his children, to keep up their incessant wailing for their father.

187. *Ka tata ki a koe nga taru o Tura!*

The weeds of Tura are near thee!

Meaning: Thou art getting grey-haired. Tura was a grey-headed man of old; his story is a highly curious one.

188. *Ka ruha te kupenga, ka pae kei te akau.*

When the fishing-net gets old, it is drifted on the shore.

Said by an old woman to her husband who neglects her.

Another of similar meaning:—

189. *He kaha ano, ka motumotu!*

A rope indeed, but become old and broken up!

Meaning: My beauty and strength are gone, I can no longer serve you. You love a younger wife.

Another of like meaning :—

190. *Kua pae nei hoki, te koputunga ngaru ki te one.*

The white foam of the surf is cast up and left on the shore.

Said by a woman getting grey-haired, when her husband seeks a new wife.

191. *Ka tangi te pipiwharauroa, ko nga karere a Mahuru.*

The cries of the glossy cuckoo are the heralds of warmth (*or* spring).

The little cuckoo (*Cuculus lucidus*) is a migratory bird, and arrives here in early summer.

192. *Penei me te pipiwharauroa.*

Like the glossy cuckoo (in his actions).

Applied to a man who deserts his children ; as this bird (like the English cuckoo) lays its eggs in another bird's nest, and deserts them.

I give now a few (out of many) short and beautiful proverbial sayings, mostly poetical, and used by the New Zealanders in their songs :—

193. *Me he korokoro tuii !*

As eloquent as the throat of the *tuii* (the sweet-singing "parson-bird").

194. *Me he manu au e kakapa !*

I'm all of a flutter like a poor caught bird !

195. *Me he mea ko Kopu !*

(She is) as beautiful as the rising of the morning star !

196. *Me he takapu araara.*

As beautiful as the silvery, iridiscent belly of the *araara* fish (*Caranx georgianus*) when first caught.

Ancient European poets have thus spoken of the dolphin.

197. *Me he toroa ngungunu !*

Like an albatross folding its wings up neatly.

Used of a neat and compact placing of one's flowing mats or garments.

198. *Me te Oturu !*

Her eyes as large and brilliant as the full moon rising over the dark hills in a clear sky.

199. *Me te rangi ka paruhi.*

Just like a delightful tranquil day ; *or*, a fine calm evening.

200. *Moku ano enei ra, mo te ra ka hekeheke ; he rakau ka hinga ki te mano wai !*

Let these few days be for me, for the declining sun ; a tree falling through many floods of waters.

Meaning : Be kind and considerate to the aged.

Used by the old, and often with effect ; of which I knew a remarkable instance that happened in 1852, when Mr. Donald M'Lean, the Land Purchase Commissioner, paid the chief Te Hapuku, the first moneys for lands

at Hawke's Bay. An old chief, named Te Wereta, who resided at Wharaurangi, between Castle Point and Cape Palliser, uttered these words, and he got a lion's share of that money—and he lived more than twenty years after.

Another of similar meaning :—

201. *Maaku tenei, ma te ra e too ana. He aha kei a koe? Kei te ra e huru ake ana.*

Leave this for me, for the setting sun. Why shouldst thou care about it? the sun just sprouting up (*or* beginning life).

I scarcely recollect a single instance of those words being advanced by the aged, (in former years), and not heeded by the younger folks. It always seemed, to me, to form an admirable trait in their character; one, no doubt, grounded on ancient custom.

202. *Whangaia ta taaua tuahine, he tangi i a taaua.*

Let our little sister be fed and nourished, to mourn over you and me (when we die).

Meaning: That a widow's mourning is soon over, for she marries again; but with a sister it is lasting and true.

This is also eminently shown in the Greek tragedies, by Antigone and Electra.—*Sophocles.*

203. *Taku hei piripiri, taku hei mokimoki, taku hei tawhiri, taku katitaramea.*

My necklace of scented moss; my necklace of fragrant fern; my necklace of odorous shrubs; my sweet-smelling locket of *Taramea.*

This affectionate and pretty distich was often sung to a little child when fondling it, expressive of love. A short explanation may be given of the four plants mentioned in it. *Piripiri* is a fine horizontal moss-like *Hepaticæ* (*Lophocolea novæ-zealandiæ* and other allied species) found in the dense forests; *Mokimoki* is the fern *Doodia caudata*: *Tawhiri* is the shrub, or small tree, *Pittosporum tenuifolium; Taramea* is the Alpine plant *Aciphylla colensoi.* From the two last a fragrant gum was obtained; that, however, from the needle-pointed *Aciphylla* only through much ceremony, labour, and trouble,—and, I may say, pain,—gently indicated in the prefix given to it in the chaunt—*kati* = sudden sharp prick, or puncture. All those scents were much prized by the New Zealanders, who wore them in little *sachets* suspended to their necks.

204. *E iti noa ana, na te aroha.*

(The gift) is very small indeed, still (it is given) from love.

205. *To Kakawai ngako nui, aroaro tahuri kee.*

Ah! you take my fine fat *Kahawai* fish (*Arripis salar*), but you turn away your face from me.

Applied to one who receives presents, but returns no love.

206. *He manu aute e taea te whakahoro!*

A flying-kite made of paper mulberry bark can be made to fly fast! (away, by lengthening the cord).

Used by a lover, expressive of impatience at not being able to get away to see the beloved one.

207. *Na to tamahine ka pai i takina mai ai tenei kekeno ki konei.*

It was thy exceedingly pretty daughter which drew this seal to land here.

This speaks for itself, and would be doubly suitable for such a person coming by *sea;* in the olden times most visits were made by water.

N.B.—The verb *taki* (pass. *takina*), means to forcibly draw a captured fish to land out of the water.

208. *E kimi ana i nga kawai i toro ki tawhiti.*

(He is) seeking after the tips of running branches which extended to a distance.

Used with reference to any one claiming distant or lost relationship.

N.B.—The terms used for runners, or running branchlets, and their spreading, are taken from those of trailing plants, as the convolvulus, gourd, etc.

209. *E raro rawakore, e runga tinihanga.*

Poor and without goods are those of the North; abounding in wealth are those of the South.

This proverb, which in *former* times I have often heard is used, is peculiarly a Northern one, and requires explanation. The most esteemed goods—the real personal wealth of the ancient New Zealanders—were greenstone—unworked or worked—as axes, war-clubs, and ornaments; finely-woven flax garments; totara canoes; and feathers of the *huia* bird (*Heteralocha gouldi*). These were all obtained from the Southern parts; so were the skilled carvers in wood (males), and the best weavers of first quality flax garments (females), who were sometimes made prisoners of war.

210. *He karanga kai, tee karangatia a Paeko; he karanga taua, ka karangatia a Paeko.*

At a call to a feast, Paeko is not called;

At a call to a fight, Paeko is called.

Used evidently by an inferior, though a good man at fighting, etc. Note the name, which may be translated, Keep them off. "Rich man has many friends".

211. *E hoki te patiki ki tona puehutanga.*

The flounder returns to its own thick, muddy water (to hide itself, *understood*).

212. *Puritia to ngarahu kauri!*

Keep (to thyself) thy kauri-resin soot!

This saying was used when a person was unwilling to give what was asked, the same being some common thing and not at all needed by the owner.

Soot from burning *kauri*-resin (a genuine *lamp-black !*) was carefully collected in a very peculiar manner and only by much pains, and buried in the earth placed in a hollowed soft-stone, where it was kept for years, and said to improve in quality by age; it was used as a black pigment in tattooing. But there is a double meaning here, *viz.:* You may never require it, or live to use it!

213. *Waiho noa iho nga taonga; tena te mana o Taiwhanake.*

Leave (your) goods anywhere; here is the power and might of the Rising-tide.

Used to strangers, to show, that the people of the place were honest, etc., and under their chief, who is figuratively called the Overwhelming Sea *or* Rising-tide.

214 *Te aute tee whawhea !*

The paper mulberry bark is not blown away by the winds.

Meaning: Peaceful times; all going on well; no disturbances.

The bark of the paper mulberry shrub, or small tree, (*Broussonetia papyrifera*) which was formerly cultivated by the ancient New Zealanders, and used as a kind of white cloth ornament for the hair, was, after being beaten and washed, etc., spread out to dry in small pieces, but only in fine, calm weather.

215. *Haere mai ki Hauraki, te aute tee awhea !*

Come hither (to us) to Hauraki, a district in the Thames, where the prepared paper mulberry bark is not blown away (*or* disturbed) by the winds while drying and bleaching.

A proverb of similar meaning to the last one.

216. *Haere i mua, i te aroaro o Atutahi.*

Go before the presence (or rising) of (the star) *Atutahi; or*, Work away diligently in advance of the appearing (of the star) *Atutahi.*

Formerly used (1.) concerning the proper time of annual friendly visiting,—*viz.*, in the autumn, when food is plentiful, and before the frosts set in; (2.) also (and more commonly), for the early digging and storing securely in their neatly-built storehouses of their precious *kumara* crop, on which so much depended; which roots if but slightly touched by frost, rotted. The star *Atutahi** rises in April, and was to them indicative of the season of approaching frosts.

* See a future paper on the astronomical lore of the old New Zealanders.

217. *Rehua pona nui!*

Rehua (causing) big joints!

Rehua is one of the larger planets (possibly Mars or Jupiter), and when seen in summer, in time of heats and droughts, this saying is used; as then men grow thin (substantial vegetable food being scarce), and their joints protrude and look large. Rehua is a famed star (planet) with the old New Zealanders,—many things are said of it; some of which, however, belong to a noted chief of that name of the olden time. (*Vide* proverb 161, *ante*).

218. *Takurua hupe nui!*

Takurua (causing) watery nose!

This saying is in opposition to the last one, conveyed in the same semi-metrical manner, and is highly expressive of the cold raw weather in winter. Takurua being also one of their names for the winter season (indeed with the Southern Maoris the only one), at which time the old Maoris, slightly clothed, must have suffered much annoyance in the way alluded to. *Takurua** is the name of a star which rises in the winter.

219. *Ka mate he tete, ka tupu he tete.*

One duck dies, another duck is hatched. (*Spatula variegata.*)

Meaning: Man dies, and another comes in his place.

Reminding of Homer (*Iliad* VI.):—" As is the race of leaves, such is that of men; one springs up and the other dies." And of our English saying:—" As good fish in the sea as ever came out of it.

220. *He huruhuru te manu ka rere: he ao te rangi ka uhia.*

When the bird has feathers it flies away; when the sky has clouds it is obscured.

Lit. The fledged bird flies; the clouded sky (is) covered.

Meaning: Great changes soon arise. Circumstances alter cases.

XIII. A few very brief and pithy Sayings (as a sample).

221. *Rae totara* = Forehead as hard as the *totara* wood.

Spoken of a liar; and of an unabashed, shameless person. Equivalent to our English Brazen-face.

222. *Tou tirairaka* = Flycatcher's tail (*Rhipidura flabellifera*).

Said of a restless person who does not sit quietly in his place at their more important meetings.

223. *Arero rua* = Double tongue.

224. *Ngakau rua* = Double mind.

Both spoken of a false promiser; of a person who says one thing, yet means another.

225. *He ringa whiti!*

A quick ready hand, at reaching out, across, or over.

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* Note on preceding page.

226. *He tangata tunu huruhuru!*

One who roasts (his bird or rat) with its feathers or hair on.

Both said of a hasty quarrelsome person.

227. *Ka kata a Kae!* = Kae laughs.

Sure to be said when a cross person smiles; or when a person discloses unintentionally his thoughts. Derived from their old legends.*

228. *Whakawaewae wha!*

Make (thyself) four legs (first)!

Used, ironically, to a person who boasts of what he can do.

229. *Nga huruhuru o oku waewae* = Hairs of my legs.

Used reciprocally: (1) By a chief, of his tribe and followers; and (2) by them of him, by merely changing the pronoun *oku* to *ona*. In this latter sense I have known it to be used beautifully and with great effect.

230. *Ka rua hoki!* = Twice also!

Meaning: Thou hast just said the contrary; two (opposite statements) indeed!

231. *Naana ki mua* = He began it.

A sentence of great service formerly, in relating quarrels, etc., and always highly exculpatory.

232. *He kowhatu koe?* and, *He kuri koe?*

Art thou a stone? *and*, Art thou a dog?

Used, generally, interrogatively, by way of prohibition, disapproval, etc., but, sometimes, with care, indicatively.

233. *He o kaakaa!*

A small bit of food for a journey. *Lit.* A parrot's morsel for its flight.

The old Maoris said, that the parrots always carried with them in one claw a small stone which they constantly nibble.

234. *He marutuna!*=Bruised *or* squashed eels!

Said of any person or thing, ugly, displeasing, or repulsive.

235. *He kupu matangerengere!*

A harsh or disagreeable word, sentence, or speech. *Lit.* A word (having a) hideously ulcerated face.

Art. VIII.—*A few Remarks on a Cavern near "Cook's Well," at Tolaga Bay, and on a tree* (Sapota costata), *found there.*

By W. Colenso, F.L.S.

[*Read before the Hawke's Bay Philosophical Institute, 8th September,* 1879.]

In reading Professor Von Haast's address to the Philosophical Institute of Canterbury, New Zealand,† which contains a full account of some "pecu-

* See Grey's Polynesian Mythology, p. 90.

† Trans. N. Z. Inst., Vol. X., pp. 37-54.

liar ancient rock-paintings in a cave or rock shelter in the Weka Pass" ranges in that provincial district, accompanied by a plate of the same,—I, at once, thought on what Polack had written, some forty years ago, of some drawings he had noticed in a cave at Tolaga Bay, where Cook had landed and watered in peace. And, bearing also in mind, what a few of the oldest Maoris there had personally told me of Cook, on my first visit to Tolaga Bay, in January, 1838 (when I also saw the hull of Polack's broken vessel), I, naturally, very much wished to know more of this cavern and its drawings; likewise of a very peculiar tree growing there, which Polack also particularly mentions. And finding that my friend, Mr. Locke, who is also a member of our Society, was going thither last summer, I requested him to ascertain, by personal inspection, all he could as to the cavern and its drawings, and the tradition about it, and, also, the said tree; and, if possible, to bring me—on his return to Napier—a specimen of this latter. This, I am happy to be able to say, Mr. Locke has since done; but before I give you his information, I will just quote from Polack's work, as his remarks here are good and brief.

Polack says: "Kani* requested me to accompany him next day to Opoutama, near the south entrance of the bay, where we should walk over the same ground and native paths that existed in the time of Cook, and which had been traversed by him. The following morning we did so * * * * Soon after our landing we reached the indent of Opoutama, beautifully situated in a dell, encircled by rising hills covered with a variety of shrubby trees. * * * * One tree was pointed out to me as peculiar to this spot, and stated by the natives who accompanied me, and whose residences were at far distant settlements on the coast, as growing only in this valley; it was in height thirty-five feet, with spreading branches, frondiferous, and of a similar colour to a species of *Phyllanthus* that is found in large quantities near the beach. The tree is nuciferous, and bore at the time clusters of early berries, which, when in a mature state, are dried by the natives, and used as beads."

"The chief now wound his way up the side of the hill, followed by myself and the friends who accompanied us. We were arrested in our progress half way by a cavern (*ana*), which stopped our further progress. Its arch was remarkably high, but of little depth; it was similarly argillaceous as the caves we had seen below in the bay. Kani enquired if I felt gratified, adding: '*E koro, tenei ano te ana no Tupaea*' = This, friend, is Tupaea's cavern. I learnt that in this cave the favourite interpreter of Cook slept

* Te Kaniotakirau, long the principal chief. I, also, saw him on several occasions; his father, Rangitumamao, did not see Cook, but his grandfather, Whakatataraoterangi, who was then the principal chief there, received Cook and his party.

with the natives:—'he was often in the habit of doing so during the heats of the day with his native friends, as is the wont of the New Zealanders,' said my conductor;—'Tupaea was a great favourite with our fathers, so much so, that to gratify him, several children who were born in the village, during his sojourn among us, were named after him.'* A few yards in front of the cave is a small hole that was dug in the granite (*sic*) rock, by order of Cook, for receiving from a small spring the fluid that unceasingly flows into it. The marks of the pick-axe are as visible, at the present day, as at the period it was excavated under Cook's eye. The water had overflowed this useful little memorial of our illustrious countryman, was pellucid and very cold. The sun had not penetrated this sequestered spot for many years, from the umbrageous *kahikatoa* and other trees that surround it.

"Around the surface of the cavern are many native delineations, executed with charcoal, of ships, canoes sailing, men and women, dogs and pigs, etc., drawn with tolerable accuracy. Above our reach, and evidently faded by time, was the representation of a ship and some boats, which were unanimously pointed out to me, by all present, as the productions of the faithful Tahitian follower of Cook, (Tupaea). This, also, had evidently been done with similar materials. This cavern is made use of as a native resting place for the night, as the villages of Uawa are at some considerable distance from Opoutama; it is mostly in request by parties fishing for the *Koura* (crawfish) and other fish, which abound in all these bays."

Mr. Locke visited the cavern and inspected it, and found that while it bore ample marks of old "delineations" such were so worn and defaced by the incessant action of the elements, and also so high over head, as to be scarcely discernible. The traditions, however, of the Maoris, respecting them and the place, were quite in keeping with Polack's relation. The perennial spring was still there, and bore its old and never-to-be-forgotten name of "*Te wai kari a Tupaea*" (the well dug by Tupaea).†

Mr. Locke also brought me a branch of the said *single* tree, which at the time of his visit was unfortunately neither in flower nor fruit. However, it was sufficient for me to identify it as being *Sapota costata*, a tree which I had first noticed in flower at Whangarei Bay, in 1836, and in fruit at Whangaruru Bay, further north, in 1841. It had been also found by Mr. R. Cunningham, still further north, in 1834, on the shores opposite the Cavalhos Islands, between the Bay of Islands and Whangaroa, and it has since been also found at Kawau, and on some other of the islets in the Frith of the

* On my arrival in New Zealand I found several natives bearing his name, mostly on the East Coast.

† A further proof of the term by which Cook and his *first* visit to New Zealand was everywhere known. *Vide* Trans. N. Z. Inst., Vol. XI., p. 108.

Thames; but this is the only instance of this tree being found so far south, and I am inclined to think this to be its utmost south range; the genus, and indeed the whole Natural Order, being tropical plants. The Maoris informed Mr. Locke that another tree of this kind grew also at Kaiawa, a little further north, and that anciently the fruit, or seed, was used as beads for necklaces: for which purpose, and by a rude people, they were pretty well adapted, from their uniform size, and possessing an agreeable glossy appearance, and having a small hole at the end in the *testa*, which might also have given birth to the notion of boring and threading.

As I find that Sir J. D. Hooker, in describing this genus, *Sapota*, has spoken of its fruit as a "berry with *one* nut-like seed,"* I will also give my short description of it, as written on detecting it (a second time), 36 years ago; as such may be of service to future botanical collectors and observers:

"On the high south headland of Whangaruru Bay, near which we landed, I discovered a clump of small trees bearing a handsome fruit of the size of a large walnut. Each fruit contained *three* large shining seeds, somewhat crescent-shaped, and having the front as it were scraped away. Its leaves are oblong, glabrous, and much veined, and its young branches lactescent. I have little doubt but that this tree will be found to rank in the Natural Order *Sapotaceæ*, and probably under the genus *Achras*. The natives call it Tawaapou."†

This, also, was its name as given by the Maoris of Tolaga Bay to Mr. Locke.

Art. IX.—*Notes on an ancient Manufactory of Stone Implements at the mouth of the Otokai Creek, Brighton, Otago.*

By Prof. Julius von Haast, Ph.D., F.R.S., Director of the Canterbury Museum.

[*Read before the Philosophical Institute of Canterbury, 7th August*, 1879.]

Amongst the many localities where traces of the former occupation by a native race are open to our inspection, there is one of some interest situated on the small islet at the mouth of the Otokai Creek, Brighton, Otago, upon which I wish to offer a few observations.

This islet is surrounded by the sea during high water, but it is evident, when the natives were here encamped, that the narrow channel now cutting it off from the mainland did not then exist.

* Handbook, N. Z. Flora, p. 183.

† *Vide* Tasmanian Journal of Natural Science, (1843) Vol. II. p. 299.

At that time it doubtless formed part of the mainland, as shown by the kitchen-middens and rude stone implements, flakes, and cores appearing exposed on both sides of the nearly vertical cliffs, in positions corresponding with each other.

This locality is the more interesting, as it belongs doubtless to an intermediate period, when the Moa had already become extinct, and when possibly cannibalism had begun to be first indulged in.

The Otokai kitchen-middens are, therefore, different from those existing near the mouth of the Kaikorai Creek, some six miles to the north, situated amongst the remarkable sand-dunes, which cover here an area of more than a square mile, and ascending to an altitude of 300 feet on the southern slopes of Otago Peninsula.

At the foot of these sand-dunes, and fronting the northern banks of the Kaikorai Creek estuary, a well-defined line of kitchen-middens lies about five feet above high-water mark, having a thickness of from several inches to more than one foot.

These kitchen-middens consist mostly of shells, of which *Chione stutchburyi* and *Mesodesma novæ-zealandiæ* are the most numerous. It is remarkable that these shells are nearly twice the size of those now inhabiting the Kaikorai estuary. In addition, *Mytilus smaragdinus* is well represented, but it is rather smaller than the same species found at present near the coast close by. *Amphibola avellana* and some others are also occurring in more or less large quantities.

Amongst these shells Moa bones are scattered here and there.

They are broken, often burnt, and have doubtless been deposited contemporaneously with the shells. It is thus evident that the Moas had already become so scarce that they only occasionally could be obtained, and the natives had to look towards getting other food as a regular means of subsistence. However, it is to be expected that more towards the centre of these sand-dunes, older deposits proving human occupancy exist, and which, as in other localities, will consist almost exclusively of the remnants of the extinct *Dinornithidæ*. Stone implements in the same locality are not scarce. They consist of very rude adzes and knives, mostly chipped from basaltic boulders obtained in the neighbourhood; however, similar tools made of flint, chert, quartz, and chalcedony are also represented.

Some few perfect and more numerous broken polished stone implements, together with whetstones and other polishing materials, were also obtained. Although I could devote only one day to an examination of this interesting locality, I was enabled to obtain a good insight into the character and position of the kitchen-middens under review, being fortunately guided by Mr. F. L. Jeffcoat of Winchendon, who lives close by, under Stony Hill,

and who has devoted a considerable time to the study of these ethnological questions.

Returning from this digression to the Otokai Creek Islet, I may observe that it consists of mica schist, with numerous segregations of quartz, by which the rock has become so hardened that it has resisted successfully the fury of the surf breaking here against the coast. These rocks rise at an average of fifteen feet above high-water mark, and are covered by five to six feet of loess, above which about twelve inches of vegetable soil has accumulated.

At the junction of the two last-mentioned beds, quite a thick layer of cores, implements, flakes, and chips exists, all manufactured from hard basaltic boulders, having been collected along the beach, derived from Cragg's Hill and the other basaltic cones in the neighbourhood. This deposit is from three to six inches thick.

Besides this manufactured material, some large flat boulders of basalt were lying amongst it, having doubtless been used as working tables by the savage artificers, while long, thin, and roundish boulders of mica schist, close to them, had evidently been employed as flaking-tools or fabricators. No signs of polished stone implements, nor of polishing material of any kind were discovered in the ditch, about two feet broad and thirty feet long, which I dug in that locality, in company with my friend, Mr. Robert Gillies, F.L.S., of Dunedin, whose hospitality and assistance I enjoyed last summer, during the time these excavations were undertaken.

However, only a small portion of this ground was examined, and I have no doubt that a great deal of valuable information is still hidden from us in that spot. There is great probability that many, if not all the more perfect specimens in the form of adzes, were destined to be polished at a more propitious season and in a more favourable locality. On the other hand, the form and finish of a number of knives, saws, drills, and spear-heads, suggest that they were used in this more primitive condition. Only a few shells and bones were mixed with these remnants of the stone manufactory, but immediately above them, and reaching to the roots of the luxuriant sward of grass covering the ground, and often to a thickness of six to eight inches, kitchen-middens had been deposited.

They consist of bones of seals, dogs, and of a variety of birds and fishes of all sizes, even the smallest kinds having evidently been used as food. As stated in the beginning, not the least sign of Moa bones was met with. Amongst these kitchen-middens two portions of a human femur belonging to a young individual were found, the bone had evidently been broken when fresh.

As there was not the least sign of any other human bone amongst the large amount of kitchen-middens exposed and examined, it would be prema-

ture to conclude from the presence of these two fragments, that the visitors to that locality were already addicted to cannibalism.

Possibly the bone may have belonged to a stranger or to a slave, having been broken at the time of death to be used for making tools. I have no doubt that further researches which Mr. R. Gillies intends to make in this spot, will throw more light on this subject. The only other specimen of human workmanship found amongst this layer of refuse is a small fish-hook made of bone. It is of a very primitive form, unlike any other I have hitherto obtained elsewhere. Of other material of the manufactory layer, there were a few small pieces of flint and chalcedonic quartz, cores, thrown away as useless.

ART. X.—*Notes on the Colour-Sense of the Maori.* By JAMES W. STACK.

[*Read before the Philosophical Institute of Canterbury, 4th September*, 1879.]

I AM indebted to Captain Hutton for calling my attention to a discussion, which took place a short time ago, between Mr. Gladstone and Mr. Pole, with reference to the colour-sense of the Greeks.

The question was raised by Mr. Gladstone, in the October number of the "Nineteenth Century" (1877), and his statements were subsequently reviewed by Mr. William Pole, in an article which appeared in the October number of "Nature" (1878), under the title of "Colour-Blindness in relation to the Homeric Expressions for Colour."

Mr. Gladstone maintains that the organ of colour was only partially developed among the Greeks of the heroic age; and supports his opinion by many examples drawn from the Homeric poems. Mr. Pole, on the other hand, maintains that Homer was colour-blind, and proceeds to establish his views by evidence drawn from his own sensations of colour, which coincide in a remarkable degree with the colour-expressions in Homer, as interpreted by Mr. Gladstone.

The question raised is one full of interest, both to the scholar and to the naturalist, whether as regarded from its bearing on the controversy respecting the authorship of the Homeric poems, or on the development of a human sense within a period of time known to history.

But I shall not presume to follow the arguments of either of these learned writers upon the question in dispute between them, neither my scholarship nor my acquaintance with the subject would entitle me to do so. Mine is the more modest task of furnishing such facts regarding the colour-sense of the Maoris, as have come under my observation, during more than

thirty years' residence amongst them; a knowledge of which may in some small degree assist those who have undertaken the solution of this very interesting problem.

It may help to render my paper more intelligible, if I state briefly what Mr. Gladstone calls the stages of the historical development of the colour-sense.

The starting point is an absolute blindness of colour in the primitive man.

The First stage attained is that at which the eye becomes able to distinguish between red and black.

In the Second stage, the sense of colour becomes completely distinct from the sense of light; both red and yellow, with their shades, are clearly discerned.

In the Third stage, green is discernible.

In the Fourth and last stage an acquaintance with blue begins to emerge.

What stage had the colour-sense of the Maori reached before intercourse with Europeans began? This can readily be ascertained by reference to the terms existing in the language at that date, for giving expression to the sense of colour.

We find, upon examination, that the language possessed very few words that conveyed to the mind an idea of colour, apart from the object with which the particular colour was associated. There are only three colours for which terms exist, namely, white, black, and red.

White, *ma* (sometimes *tea*—very limited application).
Black, *pouri*, *pango*, *mangu*.
Red, *whero*, *kura*, *ngangana*.

If we analyse these words they seem all to relate to the presence or absence of sunlight. *Ma* is doubtless a contraction for *Marama*, light, which is derived from *Ra*, the sun. *Pouri*, black, is derived from *Po*, night. The derivation of *pango* and *mangu* is not so apparent, but I venture to think that both *whero* and *kura* may be traced to *Ra*. *Ma* is not only the term for whiteness and clearness, but also for all the lighter tints of yellow, grey, and green. Grey hair is called *hina*, but the term was never used to designate anything else but hair; every other grey object was either *ma* or *pango*, as it inclined to a lighter or darker shade.

To express blackness three terms exist, *pouri*, *pango*, and *mangu*. The night was *pouri*, and any very dark tint might be expressed by the same word. *Pouri* and *Marama* were constantly used to express opposite mental conditions. *Pango* and *mangu* were applied indiscriminately to describe anything black; the former word seems to approach closely to a true colour

term, as, unlike *mangu*,* it does not carry with it the idea of relative luminosity.

To express the quality of redness we find *whero*, *kura*, *ngangana*, *uraura*, *mumura*, and in addition to these *huru kehu* to describe red hair, and *kokowai*, red ochre; but neither of these words was ever applied to describe redness in anything but human hair and ochre.

All the words for expressing redness, except *ngangana*, may I think be traced to *Ra*, and connect the Maori idea of that colour with the brilliant rays of the sun. *Ngangana* is not the word generally used to express the quality of redness, but only certain appearances of it, as in flowers or blood-shot eyes. "*Ka hete ngangana o te puawai o te rata!* = How brilliant is the crimson of the rata flowers!" *Whero* is the most commonly used term. *Kura* is used very often instead of *whero* to describe redness in any inanimate object, and is figuratively applied to anything very highly prized, probably because the scarlet feathers of the *kaka*, which were highly prized, were called *kura*. It is worthy of remark that *raukura* is the word for feathers. *Rau* means leaf, and also thatch, from leaves being used for thatching. Was the term *kura* for red suggested by the brilliant plumage of tropical birds?

Ura = redness, and *mumura* = flame, were employed to describe the flushing cheek of the warrior, or the heightened colour of the maiden. Red was the sacred colour with which sacred places and things were painted, and with which chiefs adorned their persons.

Yellow and green were recognized, not as abstract conceptions of colour, but only as they are associated with objects. *Puakowhai*, or kowhai flower, is the term which represents yellow; but *waipakurakura* is sometimes applied to yellow liquids with an orange tint = reddish-yellow.

Kakariki or *kakawariki* = green. It is worthy of remark that the word representing green has no reference to the hue of the bird's plumage, it means literally, *little parrot*. This word, slightly altered to *kakawariki*, means green lizard; and I have sometimes heard *kawakawa* used to describe green. *Pounamu* or greenstone, of which there are at least six varieties, (each known by a name descriptive of the particular tint by which it is distinguished) is sometimes used now as a colour term. *Karupounamu* = green-eyed, is the term applied to persons with light-coloured hazel eyes, but I never heard *pounamu* used to describe the colour of the sea, some hues of which it exactly resembles. Although the New Zealand flora is so rich in its varied tints of green, no impression of its prevailing colour seems to

* Ink was *mangumangu*, also *ngarahu* = ash, but the latter word conveyed no idea of colour. Ink for tattooing was called *ngarahu* because made with pine-ash, hence our ink came to be called *ngarahu*.

have been made upon the colour organs of the Maori. The word *matomato*, often employed to express the idea of greenness in vegetation, signifies luxuriance, and whatever colour-impression it conveyed to the mind would be associated with the idea of luxuriant growth.

Blue was not formerly recognized, as no word exists to represent it. Anything blue was classed with black, and went under the heading of *pouri*, or *pango*, or *mangu*. The blue depths of ocean and sky were *pouri*, or dark. At the suggestion of Europeans, the indigo-blue plumage of the *pakura* (*Porphyrio melanotus*,) is sometimes employed to indicate the colour, which before intercourse with Europeans was unrecognized.

No words are found in the Maori language to express violet, brown, orange, and pink colours; but there are no less than three words to express pied or speckled objects. *Kopurepure* = reddish speckle; *Kotingotingo* = dark speckle; *tongitongi* = spotted.

The limited number of colour-expressions that exist in the Maori language, cannot be attributed to the absence of objects presenting those colours for which the terms are wanting. If nowhere else, at least in the rainbow, they were frequently to be seen. But the Maoris appear to have had very vague ideas respecting these colours. While they regarded the rainbow as a divinity, and spoke of its exceeding beauty, they do not seem to have perceived, much less to have separated, its prismatic colours; to their organ of sight, it presented one characteristic tint, and that was *ma*, or allied to light. Its effect upon the eye was described as *aniwaniwa*, or dazzling. Further proof of their imperfect perception of colour is furnished by the fact that the Maoris have never shown any real appreciation of floral charms. It is true that the *kowhai ngutukaka*, which was said to have been imported from Hawaiki, was occasionally cultivated for the sake of its scarlet flowers, but it is equally true that flowers generally were despised, and the greatest astonishment was expressed by Maoris in the early days, when they observed the pains taken by colonists to cultivate any but flowers of the gaudiest hues.

The ornamental scroll-work, and the elaborate patterns employed in tattooing and carving, showed that the Maoris were capable of appreciating the beautiful, both in form and in colouring, and we can only account for their indifference to the more delicate tints of flowers which call forth our admiration, by supposing that their colour-sense was not so well educated as our own.

Although Maori literature is very limited, we fortunately possess a few standard works, which will always serve for reference, whenever a question may arise as to the meaning of any word in the language. One of the most reliable of these is the translation of the Bible; the work of Archdeacon

Maunsell, LL.D., a sound Hebrew and Greek scholar, and one whose knowledge of idiomatic Maori is perfect. A few references from his translation of colour-expressions, will assist those unacquainted with the Maori language to verify the statements I have made. The Greek words are from the Septuagint, the English from the Authorized Version, and the Maori from Dr. Maunsell's translation.

Red—Exd. xxv., 5, ηρυθροδανωμενα = dyed red = *whakawhero.*

Scarlet—Is. I., 18, φοινικουν = scarlet = *ngangana.*

Crimson—Is. I., 18, κοκινου = crimson = *whero me te mea whakawhero.*

Purple—Esth. I., 6, πορφυροις = purple = *papura* (this is only Maoricized English).

Green—Esth. I., 6, σμαραγδιτου = green = *kirini* (Maoricized English).

Greenish—Lev. XIII., 49, χλωριζουσα = greenish = *ma kakariki.*

Blue—Ex. xxv., 4, ὑακινθον = blue = *puuru* (Maoricized English).

Yellow—Lev. XIII., 30, ξανθιζουσα = yellow = *ma kowhai.*

Ps. LXVIII., 13, χλωροτητι = yellow = *whero.*

Brown—Gen. xxx., 32, φαιον = brown = *tongitongi*, (really, spotted.) *Vide* Gen. XXXI., 8. where ποικιλα, translated "speckled" in English, is rendered *whai tongitongi* in Maori; and again φαιον, rendered "brown" in English, is rendered *pakaka* (or *kaka* colour) in Maori.

White—Is. I., 18, λευκανω = white = *ma.*

Black—Zech. VI., 6, μελανες = black = *mangu.*

Job III., 5, σκοτος = darkness = *pouri.*

Mr. Gladstone says: "Colours were for Homer not facts but images; his words describing them are figurative words, borrowed from natural objects, in truth colours are things illustrated rather than described;" and he supports this opinion by quoting such expressions as rose-colour, wine-colour, bronze-colour, fire-colour, etc. As we find exactly the same method of expressing colour adopted by the Maoris, who spoke of *kowhai*-flower colour, little-parrot colour, we may conclude that their knowledge of colour was in a state of progression. The evidence afforded by the expressions used to distinguish yellow and green, shows that, at one period of their existence, yellow and green were confounded with the lighter shades of black and white. When the *kowhai* received its name, it was not on account of its colour, and when the parrakeet was named, it was its size, and not its colour, which attracted attention. It was after becoming acquainted with the *kowhai*, and little parrot, that they learnt to discriminate the colours. They then ceased to regard objects as merely luminous or non-luminous, but they had not yet realized the existence of colour as a quality apart from the object with which it was associated in the mind. They

appear to have reached the third stage of colour-sense development, when all at once the arrival of Europeans revealed to them the entire scale of colours possessed by the highest races of mankind. But although even elderly natives can now readily distinguish blue and brown, as distinct from each other, and from black, I do not think that any of the race see violet, magenta, orange, or any of the paler tints of any colour as we do. I have already alluded to the æsthetic taste of the Maori; their employment of such colours as they knew—red, black, and white—in scroll-painting and other kinds of decorative art, never offended the eye, and the effect produced was always pleasing. But no one can say so now their range of colours is so much wider.

They seem to have lost all sense of harmony in colouring, and to be blind to the hideous effects their false combinations produce. While only a few have had an opportunity of seeing the glaring mistakes made by the uninstructed native painters, in the use of varied colours, most persons have had an opportunity of observing the incongruous colours in which a Maori belle arrays herself, when seeking to attract admiration in our streets. Her mode of adornment proves that her sense of colour is still very defective. She knows each colour by name, but she has an imperfect mental conception of it, and therefore cannot realize what a fright she makes herself by wearing colours that will not harmonize.

The sensations produced by colours upon the organs of the colour-blind, are thus described by Mr. Pole:—"They see white, and black, and grey, just like other people, provided they are free from alloy with other colours. Yellow and blue they see, if unalloyed; and these are the only two, excepting black and white, of which they have any sensation. Red is merely yellow, shaded with black or grey; and green, orange, and violet, are confounded with black, red, white, and grey."

On comparing Mr. Pole's remarks with the evidence submitted in this paper, it will be seen that the Maoris were not colour-blind. For although, in common with the colour-blind, they confounded the lighter tints of several different colours, they, unlike them, could distinguish red and green, and were blind to *blue.*

The rapidity with which they have learnt to distinguish the colours unrecognized by them till pointed out by Europeans, seems to indicate that their want of previous perception was not the result of imperfect organization, but only of imperfect education. The only apparent difference between the Maori organ for discerning colour and that of the European was, that it was less cultivated.

ART. XI.—*Remarks on Mr. Mackenzie Cameron's Theory respecting the Kahui Tipua.* By JAMES W. STACK.

[*Read before the Philosophical Institute of Canterbury, 4th September*, 1879.]

MR. MACKENZIE CAMERON's extremely interesting communication, addressed to Dr. Von Haast,* proves the importance of securing as large a collection as possible of the obsolete phrases and technical terms employed in the mystic rites of the Maori race. For it is highly probable, as I have had occasion before to remark, that the secret of this people's origin lies hidden in those now unintelligible terms, a secret to be hereafter revealed by the researches of the philologist.

The ingenious theory founded upon the few names by which the earliest inhabitants of these islands are known, is unsupported, as far as I am in a position to judge, by existing traditions, but that is no reason for rejecting the theory altogether. The fact that the words have lost their original meaning, though it may lessen, does not destroy their value to the philologist, who, if in possession of the symbol, may recover the idea it was once formed to express.

The resemblance between the traditions relating to the *Kahui Tipua* and some of the native myths of European and other nations, is so striking, that it seems necessary to place them under the same category. It would seem as if the sight of certain objects, or combinations of objects in nature, invariably suggested the same train of ideas to men who had only reached that stage of mental progress in which the imagination is stronger than the reason. These thoughts have found expression in wild and fantastic legends, in which whirlpools are transformed into voracious marine monsters, fountains into fair nymphs, mountains into enchanted giants. Such legends must, therefore, be very carefully handled by those who employ them to trace historical events.

Before considering Mr. Cameron's derivation of the name *Kahui Tipua*, it will be worth while to examine some of the principal legends extant relating to this mythical people. Those relating to *Rongo-i-tua*, *Tamatea*, *Haumia*, and *Kopu-wai*, will suffice for our purpose. *Rongo-i-tua* = Fame-from-afar, said to be the first visitant from *Hawaiki*, is evidently identical with the *Rongo* mentioned in Mr. Gill's work, "Myths and Songs of the South Pacific," as a hero common to Polynesian mythology. He was Fame personified.

The Legend of *Tamatea's* wives, who were transformed by enchantments into stone, and the story of the impious servant's punishment, embody ideas with which readers of the Arabian Nights' Entertainments are quite familiar. The legend was either invented, or adapted from some more

* Trans. N.Z. Inst., Vol. XI., p. 154.

ancient source, to account for the existence of greenstone, which differed from other stone, not only in kind, but in the manner of its distribution; only being found in particular localities, and only in blocks of small size. Any one familiar with Cook Strait will see the fitness of the name *Kaipara-te-hau* = The wind-sports, for any headland along its coast. *Kopu-wai* = Water-stomach, represented as swallowing the enormous volume of water which flows down the channel of the Molyneux, in his attempt to intercept the flight of *Kaiamio*, seems to point to some convulsion of nature similar to that which occurred some years ago in China, when a chasm opened across the stream of the Yangtsekiang and swallowed up its waters, leaving the channel of the river dry for hundreds of miles.

The Legend of Rongo-i-tua.

Rongo-i-tua (Fame-from-afar) was the first to arrive in this island from *Hawaiki*. He found the country inhabited by the *Kahui Tipua*, their chiefs were named *Toi*, *Rauru*, *Hatoka*, *Riteka*, *Rongo-mai*, *Tahatiti*, *and Tama-rakai-ora*. On seeing the stranger, they ordered food to be set before him; and the servants brought *mamaku*, *and kauru*, *and kiekie*, and all their choice delicacies, but *Rongo-i-tua* hardly tasted anything, and presently asked for a *kumete*, or bowl of water, to be brought. This he placed behind him, so as to conceal what he did. Then, unfastening his waist-belt, he took from it some *kao*, or dried *kumaras*, which he placed in the bowl, repeating all the time the following incantation:—

** "Ka rere, ka rere, te pito nei,*
Kei te puni puninga, te pito nei,
Kei te kore korenga, te pito nei,
Kei Maatera, kei Hawaiki."

He kept feeling the *kumaras*, and when they were sufficiently softened, he mashed them into a pulp, and mixing them with the water, handed the bowl to his hosts. When the *Kahui Tipua* tasted the sweetness of the mixture, they wanted more of the food, and asked their guest where he obtained it; he told them from across the sea. Soon after this, *Tua-kaka-riki*, one of their number, found a large totara tree on the beach, cast up by the sea. He measured its length, and found, after extending his arms along it ten times, that he had not reached the end of it. Delighted with his discovery, he hastened back to the *pa*. In the meantime, *Rongo-i-tua* reached the beach, and seeing the tree, mounted upon it, and deposited his excrement near the butt of it. When he, afterwards, heard *Tua-kakariki* claiming the tree by right of prior discovery, he told the people that it could not be claimed by *Tua-kakariki*, as it belonged to him long before in

* *He karakia tenei na Rongo-i-tua mo te weteka o te tatua. Ko tenei tatua ko Mauhope* (Fasten-waist) *i roto te kumara i a Mau-hope.*

Hawaiki, from which place it had followed him ; and that if they went and examined it, they would find his private mark upon it, made before leaving home. The discovery of the excrement settled the question of ownership in favour of *Rongo-i-tua.* The tree was subsequently split in two, and out of each half a canoe was made ; one, called *Manuka*, because of the disgust expressed at the sight of the excrement,—the other, *Arai-te-Uru. Manuka* was first finished, and the *Kahui Tipua*, impatient to possess the *kumara*, sailed away to *Hawaiki* in search of it. They obtained a cargo, and returned ; but, on planting them, they were disappointed to find that none grew. In the meantime, *Rongo-i-tua* sailed away on the same errand in *Arai-te-Uru.* On reaching *Whanga ra* (sunny cove), the place in *Hawaiki* where the *kumara* grew, he ordered his men to surround the chief's house. They heard the people inside repeating the *kumara* charms and incantations. "Ah," said *Rongo*, "those *karakias* are what you need. Learn them." After listening for awhile, he and his men acquired the knowledge they needed to ensure the successful cultivation of the *kumara*. There were three divinities who presided over the *kumara* plantations—represented by three posts or sticks, which required to be set up in every field. They were named,—*Kahukura* (a male), *Maui-i-rangi* (male), and *Marihaka* (a female). Before these, the *karakia kumaras* were repeated, and little offerings of *koromiko* leaves presented. Any error made by the *tohunga* in performing the sacred rights, while *kumaras* were being planted or taken up, resulted in the death of the priest, and the destruction of the crop by the offended divinities. *Rongo-i-tua* sent his canoe back under the command of *Pakihiwi-tahi* and *Hape-ki-tuaraki*, while he remained for awhile in *Hawaiki.* The voyage was safely accomplished, and the cargo partly discharged ; but *Arai-te-Uru* was eventually capsized off Moeraki, and lost, the remains of the cargo being strewn along the coast, where at low-water it may at this day be seen. *Rongo*, desiring to return, stepped in one day from *Hawaiki* to *Aotea-roa.* The *Kahui Tipua* first saw a rainbow, which suddenly assumed the form of a man, and *Rongo* stood amongst them ; hence, he was ever afterwards known as *Rongo-tikei*, or, *Rongo*, " the Strider." *

The *Kumara* and *Aruhe* were the offspring of *Huruka* and *Pani. Aruhe* (fern-root) was the *ariki*, or lord, because it descended from the backbone of its parent ; while *Kumara* having come forth from the front was the inferior in rank.

The husband of *Pani* wondered greatly how his wife procured their food. He watched her one day go down into the water and rub the lower part of her stomach, and then he soon afterwards saw her filling baskets with

* According to some authorities, this occurred at his first appearance in New Zealand.

kumaras and fern-root. Ah, he exclaimed, it is from her inside that our food comes, so the old *waiata* says:

"Descended from the back, the great root of *Rongi*,
Descend from behind, the fern-root,
Descend from the front, the kumara,
By *Huruki* and *Pani*,
Then it was nourished in the mound,
The great mound of *Whatapu*,
Great mound of *Papa*,
Great mound of *Tauranga*;
There was seen the contemptuous behaviour of *Tu*,
There they were hungered after," etc., etc.

Alarmed for the safety of their children, *Huruki* and *Pani* bid them hide themselves; and so *Papaka*-fern went to the mountains, *Kohuruhuru*-fern went to the forests to listen to the songs of the birds, *Taroa*-fern went to the sea-shore to listen to the trampling of the surf, and *Papawai*-fern went to the river-bank to listen to the eels flopping at night in the water.

From the ancient *waiatas* we learn, that *Toi* taught people to eat fern-root and the stem of the *ti* palm; hence the proverb, "*Te kai rakau a Toi*":—That *Rongo-i-tua* introduced the kumara:—and that *Tukete* in his canoe, *Huruhuru-manu*, (bird-feather) achieved the reputation of being, like *Kupe* and *Tamatea*, a great navigator.

The Legend of Tama-tea, Pokai Whenua.
(Fair Son, the Circumnavigator)

Tama-tea, being deserted by his three wives, *Hine rau-kawa-kawa*, *Hine rau-haraki*, and *Te-kohi-wai*, sailed all round the island in search of them. And he shares with *Kupe* the credit of giving names to the various places along the coast; the promontory at the base of the On-Lookers, for instance, is known as the *Koura* fire of *Tama*, he having landed there to cook craw-fish. On reaching the southern extremity of the island, he continued his voyage up the west coast. At the entrance to every inlet he waited and listened for any sound which might serve to indicate the whereabouts of the runaways. But it was not till he arrived off the mouth of the Arahura river that he heard voices; he immediately landed, but could not discover his wives, being unable to recognize them in the enchanted stones which strewed the bed of the river, and over which its waters murmuringly flowed. He did not know that the canoe, in which his wives escaped, had capsized at this spot, and that they and the crew had been changed into blocks of stone. Accompanied by his servant, *Tamatea* proceeded inland towards Mount Kaniere; on the way they stopped to cook some birds which they had killed. While preparing the meal the slave accidentally burnt his finger, which he

thoughtlessly touched with the tip of his tongue; this act, as he was *tapu*, was an awful act of impiety, for which he was instantly punished by being transformed into a mountain, ever since known by his name, *Tumu-aki*. Another consequence of his awful crime was that *Tamatea* never found his wives, whose enchanted bodies furnish the Maori with the highly valued greenstone, the best kind of which is often spoilt by a flaw known as *tutae koka*, or the dung of the bird the slave was cooking when he licked his burnt finger.

THE LEGEND OF HAU-MIA.

Hau-mia was the son of *Kiapara-te-hau* (the wind is sporting). He belonged to the *Kahui Tipua*. At a place called the *Kohanga o Hau-mia* (nest of *Haumia*), on the face of a cliff known as *Pari-nui-awhiti* (great cliff of Whiti), you may trace the gable of *Hau-mia's* house, the upright posts, and the cross battens. It was here that *Hau-mia's* people tried to stop the canoe of the celebrated navigator *Kupe*, by placing a reef of rocks in his way, but they did not succeed, as he went far outside them and escaped.

For the Legend of Kopu wai and Arai Te Uru, see Trans. N.Z. Inst., Vol. VIII., 1877.

I now turn to the most interesting part of Mr. Cameron's paper, that relating to the derivation of the names *Kahui Tipua*, and *Ngapuhi*. After carefully examining the evidence to hand, I am reluctantly forced to the conclusion that it does not support his hypothesis. The relation existing between the Maori words and similar Indian or Malay words is undeniable, but it is explained by the fact that the races using them have a common origin. When these words are examined, it will be found that their meaning must be very much strained to make them fit in with the theory.

Kahui Tipua means in Maori a band of terrestrial monsters—an ogre or demon-band. *Hui* means to congregate; prefixed by the particle *ka*, it means a herd or flock. *Tipua* is a poetical form of *Tupua*, which comes from the verb *tupu*, to grow; the idea being that the creature so called sprung out of the earth—that it was, in fact, an ἀυτοχθων. In Archdeacon Williams's dictionary, one of the meanings given for *tupua* is steal. This is an associated meaning, and does not belong to the word in its primary sense. Terrestrial monsters being regarded as hostile to man, the word came to be used in the same way that many words are employed by us; as for instance, jockeyed, mesmerized, or macadamized. *Tipua* is sometimes applied in Maori as we apply monstrous in English.

Nga Puhi is the other name, which, singularly enough, is almost identical in appearance with the Indian words meaning serpent-race. But here again, I am inclined to think that the likeness is more apparent than real. *Nga Puhi* is a contraction for *Nga-aitanga a te Puhirere*. *Nga* is the

plural demonstrative particle. *Ai tanga* means the begotten, *a* of, *te* the, *Puhirere* (name of the father). With all but the last word, there is no need for further enquiry, as *Nga* cannot be identified in any way with *Naga*, the great serpent. But what the meaning of *Puhirere* is, may be open to discussion. *Pu* has many meanings classed by Williams under headings:— 1. Bunch, heap. 2. To blow. 3. Precise. 4. Loathing. 5. Gun. *Puhi*, one betrothed; knot on the head ornamented with feathers or flowers. *Rere*, means to fly.

The name *Nga Puhi* is borne by one of the most powerful tribes in the country, and when the chiefs have been asked about the derivation of their tribal designation, they have explained it, as being derived from the *Puhi*, or feather-ornaments of the canoe in which their ancestors came from Hawaiki. *Puhirere* may, I think, be freely rendered: "The streaming feather-ornament of the head." *Nga Puhi*, or *Nga aitanga a te Puhirere* will then mean, "*the begotten of the streaming feather-ornament;*" the ancestor being probably distinghished by some peculiar head-gear. The South Island *Nga Puhi* were descendants of *Awatopa*, and consisted of three sections: *Puhi kai ariki*, *Puhi-manawanawa*, and *Matukuherekoti*; and it was their tribe that succeeded the *Kahui Tipua.*

In connection with the name *Puhi*, attention is drawn to the fact, that a kind of eel is known by that name, but *tuna*, and not *puhi*, is the generic name. *Puhi* is merely the distinctive name of a variety, and is descriptive of some peculiarity.

I do not wish to be understood as criticizing the theory under consideration in a hostile spirit—far from it; but I am reluctantly forced to the conclusion, that the evidence furnished by the legends regarding the *Kahui Tipua*, does not support it.

The evidence of the eastern origin of the Maori is daily accumulating, and, at the same time, indications are found of the presence, in past ages, of people in these southern lands, who must have differed in many respects from the present inhabitants. The discovery by Sir George Grey* in 1839, of rock-paintings in Australia, which he said could not have been done by the blacks; and the subsequent discovery near Mount Elephant, in Victoria, of circles of stone resembling Druidical remains; regarded in connection with the gigantic statues in Easter Island, the ancient roadways of masonry in Samoa, and the rock-paintings in our own country, all open up a wide and interesting field for speculation and research, into which it is to be hoped that many like-minded with Mr. Mackenzie Cameron will enter.

* *Vide* Travels in Western Australia, by Sir G. Grey, K.C.B., Vol. II., p. 201.

Art. XII.—*Notes on the Southern Stars and other Celestial Objects.*

By J. H. Pope.

[*Read before the Otago Institute, 14th October*, 1879.]

This paper embodies the results of observations made during the last eight years. While most of the work is original, yet, when the object described is important, and an account of my observations could not be satisfactorily given without reference to the work done by previous observers, their facts and opinions have been quoted. An apology is scarcely needed for giving a short *résumé* of the facts known about the great star *Alpha Centauri;* accordingly, a very brief history of this remarkable object, from Lacaille's time (1750) to the present, has been given.

The instruments used were an 8½-in. reflector, by Browning, and a 4¼-in. equatorial of superior quality. The measures of angles and distances have been obtained by the methods described in my paper in last year's "Transactions."* The angles of position will, I have little doubt, be found to be good, but the atmosphere has not been steady enough of late to admit of the best use being made of oblique transits. I have, however, little doubt that such measures of distances as are given will be found to be very satisfactory approximations to the truth. For the spectroscopic work recorded in this paper I have used an admirable little star-spectroscope, by Browning. This instrument has enabled me to determine, quite satisfactorily, the class to which the stars examined belong, and, in many instances, to say that the spectrum lines of certain elements are probably present. As, however, the means at my disposal did not permit me to make accurate *measures* of the positions of lines, my work in this department should be looked upon as the results, so to speak, of a "flying-survey," useful perhaps, in its way, but to be superseded when more thorough and accurate determinations can be obtained.

It should be stated, however, that, while depending on eye estimation alone, it would be very unsafe for an observer to say, that a conspicuous line, for instance, in the greenish blue of the spectrum of a certain star was certainly the F. hydrogen line; yet it is unlikely that a practised eye, one trained to recognize the position of certain lines in spectra that have been already measured, could be mistaken, in any large proportion of cases, in picking out, say, the principal Fraunhofer lines in a stellar spectrum. On the whole, it seems to me that such determinations as are given in this paper, are not without a real value, if carefully made. Many years must elapse before the lines in the spectra of the Southern stars can be accurately measured by methods like those employed by Dr. Huggins. In the meantime such results as those here given are all that are available. These

* Trans. N. Z. Inst., Vol. XI., Art. X.

serve to give us a certain amount of information that can be thoroughly relied on; they enable us to state, further, that the existence of certain physical conditions, and the presence of certain elementary substances in certain stars, are highly probable; and, possibly, they are calculated to create or stimulate in us a desire to learn more certainly and fully the constitution and physical habitudes of the stars.

The objects are treated of in the order of their Right Ascension, and the places of the stars, when given, are taken from the "First Melbourne Catalogue," epoch, 1870.

The first star on the list is *Achernar*, or *α Eridani.* This fine first magnitude star is very nearly pure white, without any discernible tint, except possibly a slight shade of blue. This star belongs to Padre Secchi's first class of stars, the type of which is the giant sun *Sirius.* In the case of typical stars of this class, the spectrum is remarkable for the great breadth and distinctness of the hydrogen lines. Indeed these stars are for convenience often called "the hydrogen stars." All of them are white, or bluish-white. In *Achernar* the hydrogen lines are not nearly so strongly marked as they are in some others of the class. Indeed the star by no means nearly approaches the type, and is probably to be considered as holding a position between such stars as *Sirius* and stars of the second class, like *Procyon,* though much nearer to the former than to the latter.

π Eridani.—This beautiful little double-star is just visible with the naked eye in fine weather. It is about one degree from *Achernar*, north following. The two components are of the same orange colour, and of very nearly equal magnitudes, 7 and 7. When Sir John Herschel measured this star (anno 1835·0), he found the angle of position with the meridian to be 122·3°. Powell, in 1863, found the angle to be 73·9°. Last week (say, anno 1879·75) the angle was 58·8°. The distances for the same dates are 3·65″, 4·88″, and 5·3″. This interesting double is, therefore, very probably a binary star of comparatively short period.

θ Eridani.—R. A. 2hrs. 53min. 19·9 secs. Decl. 40° 49′—35′ 17″ S. In the Melbourne Catalogue, the magnitudes 5·2 and 6·2 are assigned to the components of this fine double star. There is most certainly serious error here. The star is plainly, taken as a whole, a large fourth, or a small third-magnitude star. Probably magnitude 3·9 for the larger star, and 5·9 for the smaller one, would not be far from the truth. The colour of the larger star is yellowish-white, with a faint green tinge; the smaller is a light shade of indigo blue. Sir John Herschel's angle of position and distance, in the year 1835·75, were 81·5° and 8·68″. The angle at the epoch 1879·75 is 85·4°. I have not been able to get a thoroughly satisfactory distance, but it is now somewhat over 10″. Time and accumulated observations will,

of course, show either that the change in the angle and the distance of the two stars of this double is owing to the proper motion of one, or both, of the components, or that θ *Eridani* is a binary system. The latter alternative appears to me to be by far the more probable.

232 *Reticuli* of the Melbourne Catalogue is a fine star of a magnificent scarlet colour. It is of magnitude 6½. There is a distant companion white star of the eleventh magnitude. The R. A. of 232 *Reticuli*, is 4hrs. 35min. 15·15secs., and the declination 62° 20′ 0·63″ S. The spectrum of this star is very remarkable. It belongs to Secchi's fourth class. The typical star of this division is small—invisible, in fact, to the naked eye; it is variable both in light and colour; it is a very distinct red, ruby, crimson, or scarlet; and its spectrum consists of bands of light, sometimes containing faint bright lines with dark spaces between the bright brands. 232 *Reticuli*, though so small, gives a fine spectrum when the spectroscope is used with the reflector, because the light is not spread out over the whole length of the spectrum, but is concentrated in certain parts of it. Thus the red part of the spectrum is very bright, but the place of the orange is occupied by a very thick black "bar." The yellow, again, is pretty bright, and so is part of the green, but towards the violet end of the spectrum the light is very faint, and the colours are quite cut out for large spaces by intervals of almost complete darkness. I failed to notice here what is said to be characteristic of this class of stars—a gradually diminishing blackness of the bars in the direction of the violet end of the spectrum; nor could I distinguish any bright lines in any part of the spectrum. The study and observation of stars of this class is none the less interesting to us, because in the present state of our knowledge their spectra are unintelligible, for it is generally felt by those who have been in the habit of observing them, that there is a great secret of nature waiting to be discovered in connection with them. Their being for the most part so very variable both in light and colour, the strongly-pronounced red colour of all of them, and their strange and beautiful spectra, all point to the conclusion, that the man who succeeds in "reading the riddle" of the nature and constitution of the red variable stars, will have made a very important contribution to our knowledge of the process by which suns and systems are evolved out of the primordial nebula, or whatever the substance may be, from which such systems are formed, and to which, perchance, when their mission is fulfilled, they again return. In the meantime these red stars seem to set anything, even like rational conjecture, at defiance.

α *Argus* (*Canopus.*)—This great star, the only rival of *Sirius*, is a hydrogen, or first-class star. In its spectrum, the F. and C. hydrogen lines, and that near G., are broad and distinct, though less so than in the spectrum

of *Sirius*. There are a great many very fine lines in the spectrum of *Canopus*, but these are not generally visible. It is only when the atmosphere is very steady and clear that they can be plainly seen. A fine line, however, or rather a small group of lines, in all probability that called *b*, and due to the presence of magnesium in the photosphere of the star, can generally be made out in moderately fine weather.

π *Argus*.—This is a wide telescopic double-star, forming, with a very distant companion of about the fifth magnitude, another double, easily visible as such with the naked eye. The colour of the large third-magnitude star is a strongly-marked orange; the other two are indigo-blue. It is a well-known fact, that a large yellow or orange-coloured star has frequently a distant companion of a blue or green colour. It is generally supposed that this is a sort of *primâ facie* evidence that the two stars are in some way physically connected. It seems to me that the existence of these complementary colours in apparently neighbouring stars in no way indicates *per se* that they are physically connected. I am inclined to think that, given a large bright orange star, with a smaller star naturally very white and nearly in the line of sight, this latter must appear greenish or bluish. The light of the bright orange star fatigues the eye as far as its power of receiving the impressions which we call red, orange, and yellow is concerned. Now, when the eye is directed to the smaller star, the less refrangible portion of the light coming from this fainter object is unable to act with its normal effect, while the green, the blue, and the violet rays, by which the eye has not been fatigued at all, produce their ordinary impression.

It is commonly said that this explanation may be true enough in a few cases; but that, if the bright star is hidden behind a thick bar placed across the field of the telescope, and the smaller star still appears blue or green, it is a proof that the light of the smaller star is really blue or green, and that its colour cannot be the effect of mere contrast. This is, I feel sure, fallacious. I have often tried the experiment and at first it was very disappointing, for one would naturally expect that a star, which appeared coloured in the presence of a very bright companion, would show its colour still more distinctly when that companion was hidden from view. But this never happened, the more completely the light of the larger star was removed, the less was colour in the companion observable. I feel persuaded that, if the light of the larger star could be entirely cut off, which by-the-by is impossible, the blue colour would entirely disappear. It is worth noting, too, that the longer one looks at a blue star, its companion being hidden, the more completely does the blue colour disappear; that is, I take it, as the eye recovers its normal condition, after being exposed to a severe strain from the light of the large star, so does

its sensitiveness to the feeble red, orange, and yellow rays of the small star return, and it sees the small star to be white or nearly so. On the other hand, I have often noticed that the longer one looks at a double star of this kind, both stars being in the field, the more pronounced does the blue become. There is only one instance, that I am aware of, in which this theory will not hold good. The small companion of α *Scorpii* is undoubtedly really greenish. I saw it on the 23rd of March, 1878, emerge from behind the moon after an occultation while its bright companion was still hidden, its colour then was a pale pea-green. There could have been no contrast here, except with the moon's light; admitting this exception, however, it seems to me highly probable that while, in such wide double stars as π *Argus* and γ *Crucis* the orange or yellow star is really what it seems, the star that appears green or blue is, *as a rule*, really white. If this view is the correct one, it follows that those observers who spend a great deal of time in observing the tints of the companions to large stars, are, to a great extent, wasting their time.

γ *Argus.*—This fine second-magnitude multiple-star has a very curious spectrum. It belongs to a very small class of stars, the only other one that I have heard of is in the Northern constellation *Cassiopeia*. In the spectrum of γ *Argus* there are certainly three very *bright* lines, one rather faint, and, I believe, many finer ones. I am almost certain, too, that there are several fine dark lines in the spectrum. The brightest line is, not improbably, the F. hydrogen line; and the somewhat fainter one, the C. hydrogen line. Of the other two very distinct bright lines, one is certainly not very far from the position of the D. sodium line; but I cannot place the other. The presence of bright lines in the spectrum renders it far more difficult than usual to estimate the positions, but the other line seems to be about one-third of the distance from D. towards the iron line E. Not improbably then, outside the photosphere of γ *Argus*, there are ever-present enormous masses of hydrogen and sodium, as well as other substances in the gaseous condition, which have been ejected from the more central parts o this sun; and, the temperature of these incandescent gases being much higher than that of the solar photosphere below, their spectrum is superimposed on the ordinary spectrum of the star proper.

ε *Argus.*—This yellow star belongs to Secchi's second class. In these stars the lines are very fine, and not easily seen unless the weather is very favourable. To this class our sun belongs. In the spectrum of ε *Argus* the F. line can be seen pretty easily, but the D. sodium line seems to be the most distinct of this spectrum.

β *Argus.*—Magnitude, one and a-half. Colour, white. A first-class star. The hydrogen lines are pretty broad and distinct.

The blue Planetary Nebula near the Southern Cross.—This object, No. 3365 in Sir John Herschel's Catalogue, is in R. A. 11hrs. 44min., and decl. 56° 31′ S. The colour of this strange object is a bright unmistakable blue. This nebula, like other planetary nebulæ that have been examined in the Northern Hemisphere, gives a spectrum of one bright line. Possibly, in a larger instrument, more lines might be seen. It is, of course, impossible with my apparatus to determine the position of this line, as there are no landmarks, so to speak, to guide one to a decision. It is most probable, however, that it is one of the hydrogen or of the nitrogen lines, and that this planetary nebula is a spherical mass of one or both these gases in an incandescent state.

α Crucis.—This superb *pair* of stars, by far the finest in the sky, consists of two stars, bluish white in tint, and very nearly equal in size, each being of the second magnitude. There is a distant six-magnitude companion, of a sea-green colour, as well as three smaller comites of magnitudes, 12½, 14, and 13 respectively. These latter are well seen in the 8½-inch reflector, but a small telescope of course does not show them. I have made a very great number of measures of the angle of position of this star, and having weighted the observations with reference to the state of the atmosphere, etc., at the time when the measures were taken, I find the angle of position for the year 1878·7 to be 118·5°. This, by a very singular coincidence, is exactly the same angle as that obtained by Powell in the year 1863. Herschel gives the angle for 1835·33 as 120·6°. I may say that, if I had rejected two of my observations, which were made in rather bad weather, and which exceeded the average of the rest by 1½° and 3½° respectively, the angle obtained, taken in connection with Powell's and Sir John Herschel's, would have indicated, I believe, a very slow but really regular angular motion, in a retrograde direction, since Herschel's time, and would, with the measures of distance given below, have convinced me, at all events, that *α Crucis* is a binary star of very long period. The temptation in such cases to "cook one's accounts" a little, to omit taking into account facts or numbers which do not square with one's own views or wishes, is very strong, but the man who cannot resist it had better give up science altogether and take to something else in which it is not of vital importance that he should tell the truth, the whole truth, and nothing but the truth, with regard to his observations. The distance between the two stars at the epoch, 1836·36, was 5·65″; in 1863, Powell made it 4·98″; and at the end of last month, 1879·75, the distance, a mean of several measures, was 4·79″. *α Crucis* is a hydrogen star, but its spectrum is very difficult to observe, except in the finest weather. Even then the only lines that I can make out are the hydrogen lines, and they are by no means very easy to see.

γ *Crucis.*—It has been customary for astronomers to catalogue this star—the "Head of the Cross"—as a double star; but the proper motion of the large orange-coloured star is rapidly carrying it away from its five-and-a-half-magnitude blue companion. The spectrum of γ *Crucis* is perhaps the finest of all stellar spectra. The groups of lines are so numerous and so well marked that this spectrum may be observed under almost any atmospheric conditions, if the star can be seen at all. γ *Crucis* is a typical star of Secchi's third class, which are all orange colour verging towards red. In their spectra there are numerous, easily-seen, close groups of lines; but the hydrogen lines are either very indistinct or altogether absent. α *Orionis* and α *Herculis* are good specimens of the two principal subdivisions of this class. In the spectrum of γ *Crucis* there are at least eight broad groups of lines, and some of these occupy the parts of the spectrum at which sodium, iron, magnesium, and calcium lines are found in the solar spectrum. But, because they are groups, it is much more difficult to say whether they contain the lines belonging to those elements or not, than it is in the case of a first or second-class spectrum. Still, I anticipate that careful measurements will confirm my opinion that iron and magnesium lines, especially the latter, are present in the spectrum of this star; the sodium line is probably there too. There is, also, a fine line just at the part where the green merges into the blue of the spectrum. This is possibly the F. hydrogen line.

There is one very significant feature in this spectrum, so at least it seems to me. It is well known that when the Sun is near the horizon, especially in damp weather, his spectrum contains certain groups of lines which are due to the aqueous vapour in our own atmosphere, and that, as he reaches a greater altitude, these lines become faint or disappear. Now, two at least of the groups in the spectrum of γ *Crucis* appear to occupy the same position as two of the principal groups of atmospheric lines. Now this being verified, important conclusions might follow. Secchi, on grounds of this sort, infers the existence of aqueous vapours in the neighbourhood of sun-spots. The spectroscope knows nothing, so to speak, about distance, except indeed where motion of approach or recession is concerned. If these aqueous vapour-lines are produced in spots on the sun, may they not be produced in much the same way in γ *Crucis*, the principal difference being that on the distant star the cause is more general and the effect greater than it is on our own Sun. If I am not mistaken, the existence of these spectrum lines should enable us to read a certain portion of the "life history" of a star.

This history might be something like this: Let us suppose that, countless ages ago, γ *Crucis* was a white star, like *Sirius*. It was then far more

intensely heated than it is now. All the elements of which it is composed were there uncombined. Hydrogen, the gas of the smallest density, ordinarily extended furthest from the centre of the globe, and this hydrogen, its outer envelope, was nearly always near the confines of the normally cold regions of space. Thus it would have a somewhat lower temperature than the rest of the sphere, and hence well-marked hydrogen lines would appear in its spectrum at this period. Comparatively small quantities of other elements, however, would frequently be erupted from the interior portions of the sphere, and would reach what may be called the surface. The presence of these would cause the appearance of numerous fine lines in the spectrum. As eternity went on, if I may use the expression, the star radiated a large portion of its heat into space, the elements began to combine chemically to a certain extent, large volumes of hydrogen ceased to exist as such, through combining with oxygen and forming water-vapour, of which the outer star envelope would now consist. In place of the hydrogen lines of the white star therefore, we now find the aqueous vapour spectrum—"the atmospheric lines" as they are called. The result of the combination of the oxygen and the hydrogen would, of course, be a great decrease in the volume of the outer envelope. This would probably bring the lines of sodium, magnesium, iron, and calcium into greater prominence, and we should have the spectrum which γ *Crucis* now presents. Between the two conditions described there would be an intermediate one. Through such a stage our Sun may possibly be passing now. It may be, in short, that our Sun was once a *Sirius*, is now a *Procyon*, and will by-and-by be a γ *Crucis*. This is a mere hypothesis, of course, though it appears to account pretty fairly for some of the phenomena of the stars. In fact, I give it merely as a suggestion, feeling that it is as little entitled to carry weight with it as an hypothesis, founded on observed phenomena and not at variance with known facts, can be.

γ *Centauri.*—R. A. 12hrs. 34min. 21·46secs. Decl. 58° 14′ 43·24″.—This is a very fine close pair of stars, each component being of the fourth magnitude, and purely white. In his "Results of Observations at the Cape of Good Hope," Sir John Herschel gives the position-angle as 354·3°, the epoch being 1835·89, while the distance is stated to be ¾″. To this estimate of distance Herschel attaches no value. For the year 1878·93 the angle of position is 6·6°, or 186·6°, and the distance 2·2″.

β *Crucis.*—This fine white star has a distinct deep blood-red companion, the position angle being 260½° and the distance (1879)–208″. It seems to me that the small star varies in size from about the eleventh to nearly the eighth magnitude. It would be well if the small star could be watched, so that its period and the amount of its variation in brightness might be accurately ascertained.

a Centauri.—R. A. 14hrs. 30min. 47·07secs. Decl. 60° 17′ 53·93″. Magnitudes, 1–2. The following table will give the position-angles, and the distances of the components of this star, for selected epochs during the forty-five years which have elapsed since 1834, when it was first accurately measured by the greatest of all astronomers, Sir J. Herschel:—

OBSERVER.	DATE.	POSITION.	DISTANCE.
Sir J. Herschel	1834·7	—	17·43″
Sir J. Herschel	1834·8	218° 30′	—
Sir J. Herschel	1835·7	219° 30′	—
Sir J. Herschel	1837·3	220° 42′	—
Sir J. Herschel	1837·4	—	16·12″
Powell (from Webb)	1864	5° 7′	7·85″
Computed from mean places in F. M. G. C.	1870·0	17° 19′	10·73″
My recent measures	1878·7	156° 19′	—
My recent measures	1879·75	183° 8′	4·55″

With this table as a basis, it will be found that the major axis of the apparent orbit lies nearly in the direction 26½° to 206½°, and that the greatest elongation north is about 11″, while the greatest elongation south is 27″. Mr. Powell makes the period between 76 and 77 years. If the places of the two stars given by Lacaille (1750) were correct, however, the period would be just about 85 years, for the angle of position computed from his places of the stars is 218° 44′, which a reference to the above table will show, was very nearly Sir John Herschel's micrometrically-determined position 84·79 years afterward. As, however, the *distance* obtained by Sir John Herschel disagrees very materially with that deduced from Lacaille's places of the stars, but little weight is attached to the observation of 1750.

This magnificent double star is the finest object of the kind in the heavens. Besides being a binary star of very short period, every one knows that *a Centauri* is our next neighbour among the stars, and that it was the first to give up the secret of its parallax under direct Transit Circle observations. The colour of this star is straw-yellow, or sometimes golden-yellow, according to the state of the atmosphere. When there is haze, of course the smaller star is somewhat more affected by it than the larger. This tends to give it a slight brownish tint when the sky is not clear. *a Centauri* is a star of the second class. Its spectrum is very like that of the sun. Even the principal dark lines are fine, and they apparently occupy the same relative positions as do the well-known lettered lines in the solar spectrum.

The resemblance between the two spectra is so striking that any one seeing the two spectra for the first time could hardly fail to notice the similarity. More dispersive power, however, and the means of accurately determining the position of the lines of *a Centauri* might show that they are not the

same as the solar lines. Such a result would surprise me much. The D. sodium line, the E. iron line, the *b* magnesium line, and the F. hydrogen line of the Sun have, almost certainly, their counterparts in the spectrum of *α Centauri*. There can be little doubt that the physical constitution of this great star is, in most respects, the same as that of the Sun. It is probable, however, that *α Centauri* is less developed than the Sun; for, as Mr. Proctor has pointed out, its light is brighter than its mass would lead us to expect it to be, judging from the light of our Sun, as compared with his mass. While the mass of the star is to the mass of the Sun as 2 : 1, the light of the star is to the light of the Sun as 3 : 1. Now, if it is true, as physicists have good grounds for believing, that the Sun is, and has been, very slowly but surely losing his heat, just as our earth has most certainly lost an enormous amount of hers, there must have been a time when the Sun and his system were less developed, but far hotter and brighter than they are now—when they formed, probably, as I said when speaking of *γ Crucis*, a white star—that is to say, there was, quite possibly, a time when the light from our Sun bore the same relation to his mass as the light from *α Centauri* bears to its mass. We may also believe that matters are less advanced in the planets (if there are any) of this neighbouring system than they are with us.

α Trianguli.—The spectrum of this star is not very striking, but it is rather curious, as showing, apparently, that the star is in a condition intermediate between that of *α Centauri* and that of *γ Crucis*. The lines of the second class, and also the groups, are very faint, but they are there. It will be seen that this fact has some bearing on the suggestion I made respecting the gradual development of stars while speaking of *γ Crucis*. Here it looks as if we had, so to speak, caught a star in the act of changing from the second to the third class. What I have seen of the spectra of the stars, so far, leads me to think it probable that if every star, down to the sixth magnitude, could be examined even with my instrument, and mapped roughly, it would be found that the spectra obtained could be so classified that a series might be made, each member of which would differ from the next almost insensibly. This, of course, would take a long time to do, as small stars can be examined only in very fine weather. When it was done, however, the results would be very valuable and interesting.

α Gruis.—This is a second-magnitude white star, with the usual spectrum crossed by distinct hydrogen lines.

β Gruis is a second-magnitude star, and nearly as bright as the *lucida* of this constellation. Its colour is reddish-orange, and its spectrum is much like that of *γ Crucis*, but the groups of lines are not so distinct, and, generally, there is a sort of approach to the appearance presented by

the spectrum of *Mira Ceti*, which I find thus described in my note-book, under the date October 8th, 1878 :—" Saw to-night the spectrum of *Mira* : it is really wonderful—something like that of *a Herculis*, as given by Chambers. It seems to consist of bright broad bands, with narrow ones in between. These bands are dark, but hardly black. The effect produced is, as it were, that of an irregular set of columns. The brighest part of the spectrum is at the yellow and the green."

a Piscis Australis (*Fomalhaut*).—This star is visible at home sometimes, but its altitude there is so small that it can scarcely be properly observed with the spectroscope. *Fomalhaut* is a first-class star of the most pronounced type ; it is very remarkable for the great breadth of the F. hydrogen line. In *Fomalhaut* it is far broader than it is even in *Sirius*. As an increase in the breadth of the hydrogen lines has been shown to be due to increased pressure, and as the increase in breadth is also proportional to the pressure brought to bear upon the gas which gives the lines in the spectrum, we may, I would venture to suggest, conclude that the pressure at the surface of this star is extremely great. That is to say, *Fomalhaut* is either extremely dense and compact, so that its radius is very small compared with its mass (which is not very likely), or it is one of the very largest stars in the sky.

In conclusion, I would ask you to overlook any faults of style that may be observable in this paper. It claims to be nothing more than its title announces it to be—" Notes on Southern Stars."

Art. XIII.—*Partial Impact (Paper No. 3): On the Origin of the Visible Universe.* By Prof. A. W. Bickerton, F.C.S., President of the Philosophical Institute of Canterbury.

[*Read before the Philosophical Institute of Canterbury*, 13*th Feb*., 1879.]

In the paper I am now submitting to the Institute, I shall attempt to show that almost the whole of the visible universe may have been formed by two stupendous bodies travelling independently in free space, being brought together by their mutual attraction, and coming into partial collision. I shall in the first part explain the kind of system the naked eye and telescope show the universe to be. Secondly, I shall attempt to show that a system resembling it most strikingly in its more salient features, corresponds to one of the possible stages which would result from the partial collision of two cosmical bodies.

The belt of luminous cloud which is seen as a bow spanning the heavens from horizon to horizon, is familiar to everyone ; and to a large number

here it is also familiar as an object which may be seen at the antipodes, thus showing that it extends as a ring around the entire globe, following almost exactly a great circle of the heavens. This is the so-called milky way, which all astronomers tell us consists of tens of millions of separate stars, many of them probably equal to, and some of them larger than, our sun. It is only necessary to look in the same direction on any clear summer night, as twilight is giving place to darkness, before the small stars are visible, to see that almost all the stars then visible lie in a long broad belt from *Alpha Centauri* to *Orion*. This is so striking that if you ask anyone what is the distribution of the stars, this feature cannot fail to be observed as a stream of stars. Wait a little longer and observe the milky way: one end of the stream of stars will be found to lie on it, but makes a very small angle with it. Again the winter aspect of the milky way suggests exactly the same idea, with this striking addition, that parts appear to start away from the main ring in a series of streams frequently corresponding with sprays of stars. Again, Proctor says, "that the stars of the first six orders are gathered into two definite regions, a northern and southern, so markedly, that the distribution of stars within these regions is richer than the distribution over the rest of the heavens in the proportion of five to two." Thus the mere naked-eye appearance of the heavens points to its being a definite system, and the older philosophic writers have often called attention to this fact. Wright, Kant, Huygens, and many others expressed themselves strongly on the order of the heavens, and appear to have had no doubt of its being either one or more systems, and several have classified these systems into various orders, of which the visible universe does not appear necessarily to form the highest order. Kant says, speaking of the systems really known, "we trace here the first terms of a series of worlds and systems, and these first terms of an infinite series enable us to infer the nature of the rest of the series." But if the naked-eye view gives it the appearance of a definite system, it will be seen that telescopic observations demonstrate the fact. Sir J. Herschel, who studied star-distribution more that any other man, says that the mass of stars is generally flat, of small thickness. He also says, that the number of stars visible in his telescope in the milky way number about eighteen millions, and about two millions in the remainder of the celestial vault. Struve published a list of stars in which he showed that in equal areas there were 4¼ at the poles of the galaxy to 122 in the galaxy itself. Herschel also says in another place—That beyond a certain magnitude all the stars lie in the milky way. There is another feature of the heavens which the telescope reveals to us, namely, the nebulæ at the poles of the galaxy, and the star-clusters in the galaxy itself. Mr. Cleveland Abbe, from Herschel's catalogues, says:—"Imagine a belt thirty

degrees wide, extending around the heavens, including the milky way. * * * This belt will include one-fourth the surface of the celestial sphere. * * * Here we find nine-tenths of the star-clusters, and one-tenth of the nebulæ." In another paper I shall attempt to show that most likely these few nebulæ are not of the same order as the polar nebulæ.

Proctor, who discussed these facts very fully, after showing that star-clusters essentially belong to the galaxy, and, as we pass from that great circle, we go through regular stages of lessening solvability to the galactic poles, and there the nebulæ are completely irresolvable, says:—"I believe that cause may be assumed not unreasonably to be the difference in the circumstances under which the galactic and extra-galactic nebulæ have reached their present state." Again, in respect to the nebulæ at the poles of the milky way, Proctor shows that every theory of their existence is ridiculous, "unless we concede that the nebulæ belong for the most part to our galactic system." The accompanying charts and sketches by Sidney Waters, Proctor, and Newcombe, show strikingly this most remarkable arrangement. Thus, so far, we see that the milky way is a region of stars and star-clusters, and that the poles of this ring are regions of nebulæ. I shall now show that our sun occupies roughly the centre of this system, in a region poor in stars. Proctor says, after a very long discussion of the question, "all these phenomena point to the conclusion that the milky way, in this neighbourhood at any rate, is really what it appears to be—a belt or zone of stars, separated from us by a comparatively starless interval." After discussing various hypotheses, he says:—"In either case we must assume that our sun is not very far from the centre of the system." The picture of the universe we obtain from these extracts is a clear and distinct one. But perhaps the most striking argument that has yet been offered for the common origin of the universe is that of the spectroscope; which shows identity in the composition of the sun and stars with the elements to be found in the earth. The analyses of meteorites, in which no extra terrestrial element has ever been found, clearly point to the same conclusion.

I will give the opinions of a few astronomers on the evidence I have offered. Sir William Herschel distinctly states, that any sound theory of the universe must account for the peculiar arrangement of the nebulæ. Proctor, in speaking on grounds of probability, says:—"Where the results are in direct contact, the rich regions for one order corresponding to the poor regions for the others, and *vice versâ*, the two orders of objects belong to one system," and again says that he knows of no single reason for supposing these nebulæ to be external galaxies. That nebulæ are not external galaxies is proved from the facts recorded by Schmidt, Hind, and others,

that nebulæ have been observed to vary and disappear, which is clearly impossible with a galaxy like our milky way. I will only give one other extract from among a large number. It is from the same work ("Proctor on the Universe"), which is wholly devoted to demonstrate these conclusions. "The phenomena I have been discussing seem to point to conclusions very different from those which have been usually accepted respecting the visible universe. Instead of separating the stars and nebulæ into distinct systems, or rather of looking on the stellar system as a member of the system of nebulæ, we seem compelled to look on almost every object visible even in the most powerful telescope, as a portion of one system, which comprises within its range, simple, multiple, and clustering stars, irresolvable nebulæ, gaseous bodies of symmetrical and unsymmetrical figure, and in all probability myriads of other forms of matter as yet undetected."

These are the more general conclusions as to the constitution of the heavens. There is a great deal of special evidence pointing the same way; but I can only mention it here. I refer to the fact that nearly all the temporary and variable stars are in the milky way, the community of motion of groups of stars, the tendency to stream formation, and the special character of the milky way nebulæ. But what I have already discussed is sufficient to show distinctly that our universe is one system of definite construction. It undoubtedly consists of a ring or spiral of stars, star-dust and star-clusters. About the centre of this ring our sun is situated, in a comparatively sparsely-spread region. If we suppose a line to pass through our system, at right-angles to the plane of the galaxy, it passes in each direction through a region of thousands of nebulæ—these nebular masses being, as it were, polar caps covering approximately one-sixth the celestial sphere. It is certain that such an arrangement is absolutely incompatible with a chance distribution, and that consequently it offers a perfectly legitimate ground for scientific induction. In offering this hypothesis I do so with the more confidence as it is probable that every wide generalization tends to give direction to much successful research, the results of which are of great value, although some of these may convert the hypothesis into mere scaffolding, to be removed when the structure is complete. I shall *assume* the existence of large bodies without discussion, as such discussion is antecedent to the especial purpose of this paper, and besides, would unduly increase its length, which is too great already. I propose to discuss their claim on your consideration in a future paper. I will, however, call your attention to the present views of mathematical physicists, which point to the final state of the universe being one gigantic body, with all the energy dissipated as uniformly diffused heat. If, therefore, we may look forward to such a body in the future, why not in the past? I will not, however,

go quite so far as to suppose the body cold. I shall assume two stupendous bodies, having small independent proper motion in space, being probably at exceedingly high temperatures, endowed with a considerable rotation, and having a large number of bodies revolving around them, and not unlikely making up a considerable proportion of their mass. The probable existence of such bodies is rendered likely on the view of the cosmogony which follows as a logical deduction from thé conception of partial impact.

I will now place before you some of the broader conclusions which are general deductions to all cases of partial impact :—

1st. The original independent motion of the bodies acts in three ways—(*a*) it tends to render the impact more partial; (*b*) in those parts coming into impact, it increases the temperature; and (*c*) it tends to increase resultant velocity, and hence the escape of the several pieces.

2nd. At impact, all parts coming into actual collision will have a part of their molar motion converted into heat, and the more completely the parts coming into impact destroy each other's momentum, the higher the temperature of those parts. On the other hand, as those parts will possess no molar motion they will tend at first to occupy the centre of the mass.

3rd. In partial impact the whole motion (except that due to original rotation and to pressure) will tend to lie in the plane containing the line joining the centres of gravity, and containing the direction of motion of the two bodies at impact. This plane is doubtless the great circle bisecting the milky way, and might be considered the ecliptic of sidereal astronomy.

4th. A tendency to rotation must be produced which at first will be generally in one direction. This may pass through an apparent irregularity, but finally, on the condensation of the mass, some would exist.

5th. After some time has elapsed, the whole of the motion being originally nearly radial, and chiefly occupying one plane, will tend to develope an irregular ring consisting of several roughly spiral masses.

6th. All original rotation, both of bodies in orbits and of the large masses themselves, will tend to destroy the symmetry of the ring, and to take the matter from its plane.

7th. Generally, considerable irregularities in matter not uniformly spread will tend to increase themselves. Thus, if a hole appears in an infinite flat disc, attraction will tend to make it greater; and again, a break in a ring will tend to increase in width, the ring itself tending, of course, to diminish its mean diameter.

8th. The chief of the molecular motion (heat) will act radially in all directions, and consequently will change the disc (which resultant motion of mass tends to develope) into a lenticular mass.

9th. The varying velocity of different chemical substances at the same temperature, when acted on by gravity, will tend to separate this lens into

a nucleus and an escaping envelope; in some cases, the envelope alone will exist.

10th. This envelope tends to separate into three parts; the edge, which follows the general ring of matter, and two saucer-shaped masses at the extremity of the axis.

11th. Impacts of large bodies are not mere pictures of small impacts, as all such energies as cohesion, latent heat of fusion and volatilization, dissociation, etc., are constants, which form but a small portion of the total energy in large impacts, and are large ratios in small impacts.

12th. In all partial impacts there is a tendency to cause the escape of fragments beyond the range of effective attraction. Doubtless in all impacts some of the lighter elements may have molecular velocity sufficient to escape.

13th. Also, in all partial impacts the coalesced mass is formed of parts of both bodies.

14th. Partial impact, consequently, leads to a community of chemical material throughout the entire universe.

I have now given a picture of the universe, drawn from absolutely independent observations, and also, I believe, a set of logical deductions from "partial impact," and it will be in the knowledge of many here that these deductions were worked out before I had studied the construction of the heavens, as exhibited by modern research. We will now compare the result of astronomical observation with the theory of partial impact.

1. Theory says, all matter of the universe should be common, that is, composed of the same chemical elements; observation shows this to be the case.

2. Theory says, the chief of the matter should lie in one plane; astronomers say it does.

3. Theory shows that at one stage, resulting from partial impact, the matter should be roughly in the form of a ring; naked eye observation shows it to be so.

4. Deductions on principles of energy show that the axis of this ring should be the hottest; the sheets of nebulæ at the poles point clearly to this having been the case.

5. The heat being greatest at the centre, the centrifugal force should be least. Proctor says, in his essay on the universe, speaking of the origin of the polar nebulæ, that they may have been formed "through the influence of the same principle which makes the centrifugal force near the poles of a rotating globe less than that at the globe's equator"—a really surprising remark, considering Proctor had no inducement other than actual observation to make it.

6. The most casual study of "partial impact" shows that for a long time after impact, at least, streams and sprays of fragments must exist, and also that there should be considerable community of motion. Proctor has demonstrated this to be the case.

7. Original rotation of mass would tend to take material slightly out of the ecliptic as streams. Original orbital rotation of smaller bodies would tend still more to take these bodies out of the general plane, but more irregularly. This appears to explain much of the definite irregularity of the visible universe.

Besides these general agreements, all the minor observations I have mentioned seem to point quite to the same conclusion. How like a continuance of the original motion does the clustering of the stars at opposite points in the ring appear.

The varied motion in the plane of the ring must produce many collisions, resulting in temporary and variable stars, and nearly every one of these is in this plane. Nebulæ of definite structure, such as planetary and annular, probably originate in the same way, at least partial collision offers a perfectly intelligible account of them, and I know of no other that does. These are also in the same small area in the heavens.

Speculation concerning the origin of the hollows in the milky way, also in the milky-way nebulæ, and relating to these bodies themselves, as well as the Magellanic clouds, so also discussions relating to the available energy, the cause of the extinction of light and of the stability of the cosmogony, although belonging to this subject, must be left to future papers.

I cannot conclude the brief account of this wonderful and beautiful galaxy, of which our earth forms so minute a portion, without hoping that it may induce others to enter this fascinating and extensive field of research; —workers whose time and skill in observing, and whose higher mathematical training may enable them to deal exhaustively with some of the many and original difficult problems which this view of the universe suggests.

ART. XIV.—*Partial Impact (Paper No. 4): On the General Problem of Stellar Collision.* By Prof. A. W. BICKERTON, F.C.S., President of the Philosophical Institute of Canterbury.

Plate VI.

[*Read before the Philosophical Institute of Canterbury, 27th February,* 1879.]

THE papers I have presented to the Institute on the possible phenomena connected with the partial collision of cosmical bodies, show that this variety of impact is deserving of very careful study. I shall, therefore, in

this paper, attempt to demonstrate that, with the known distribution of motions of the stars, collisions are inevitable, and that nearly all these must be partial. Secondly, I shall show that there are a large number of influences which will tend to modify and to give variety to the phenomena of partial impact. But that, nevertheless, there are several well-marked peculiarities associated with all such cases of collision which render them perfectly characteristic. Lastly, I shall refer to some of the variety of cosmical phenomena which these peculiarities may give rise to.

For some time an idea was common that the whole of the visible Universe was a stable system, and that all the stars in the heavens, including our own, were rotating around a certain definite place in the heavens. This opinion was shared in by nearly all who took part in the discussion on my first paper. Doubtless there is considerable community of motion in some parts of the heavens, and it is not improbable, looking at Proctor's stellar motion chart, that, taking the whole galaxy, there may be a tendency to motion, more in one direction in the galactic ring than in the opposite; yet it is certain that the stars of the galaxy are far from being a really stable system in which all the motions are exactly recurrent in definite periods. I will give the opinions of a few astronomers on this point.

Newcombe says:—"We may first assert, with a high degree of probability, that the stars do not form a stable system." * * * "But the most conclusive proof that the stars do not revolve around definite attracting centres is found in the variety and irregularity of their proper motion." * * * "The motion of each individual star is generally so entirely different from that of its fellows as seemingly to preclude all reasonable probability that these bodies are revolving in definite orbits around great centres of attraction." * * * "And thus it (each star) may keep up a continuous dance, under the influence of ever-varying forces, as long as the Universe shall exist under its present form." Again, Herschel says of Madler's suggestion, that the stars revolve around the *Pleiades*:—"That the situation is in itself utterly improbable, lying as it does no less than 26 degrees out of the plane of the galactic circle, out of which plane it is almost inconceivable that any general circulation can take place."

Proctor unfavourably reviews this hypothesis in several of his works. In one place, after a full discussion, he says:—"These and other considerations have led all the most eminent of our modern astronomers to look upon Madler's hypothesis as one which in the present state of our knowledge we have no right to look upon with favour."

Newcombe says of Madler's hypothesis:—"But not the slightest weight has ever been given to it by astronomers, who have always seen it to be an entirely baseless speculation."

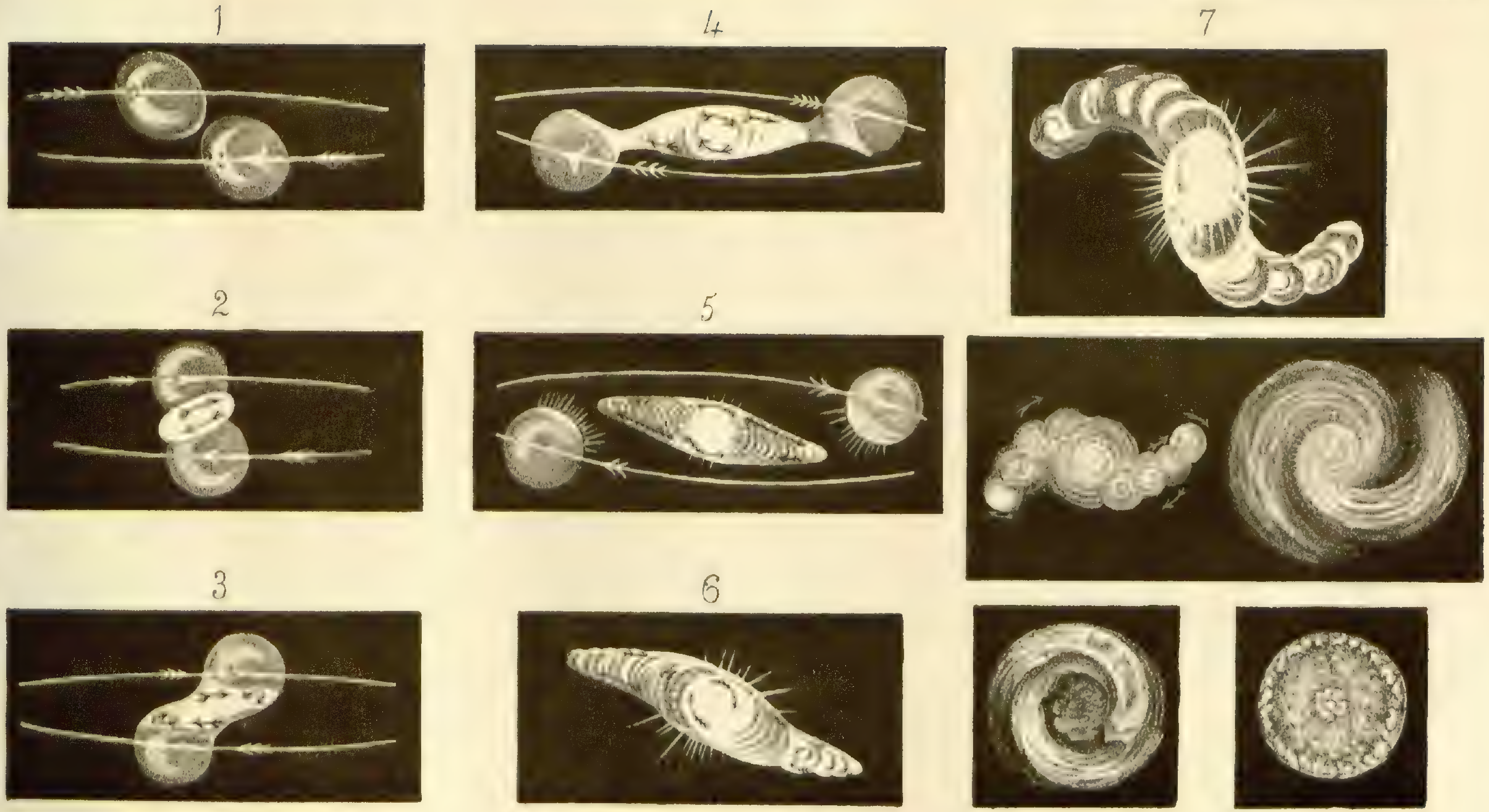
This evidence seems to be indisputable. The stars appear to be something like the molecules of a heated gas, in motion in all directions, and like these necessarily sometimes coming into impact. But many stars will come within the effective attraction of other stars, and this attraction will be enormously more effectual than mere chance in producing collision. Thus the star *Alpha Cygni* is almost directly approaching our sun, and it is extremely likely that in one or two hundred thousand years it will be for thousands of years the nearest star, by many times in the heavens, during which time, by their mutual attractions, the Sun and this star will probably be deflected several diameters towards each other out of their respective independent paths. That stars are thus brought within each others' attraction is borne out by the fact observed by Mr. J. W. Wilson, of Rugby, that the constituents of the double-star *Castor* are moving in hyperbolic orbits, and it would be well worthy of careful observation to ascertain if any other of the binary stars are thus connected. I will not prolong this discussion, for it appears certain that cosmical collisions must occur. That they do occur on a small scale is evident by the stupendous number of meteorites which strike the earth every year, and Proctor's idea of the small craters on the Moon's surface is that they have been formed by meteors falling on its surface during the Moon's viscous condition; clearly what occurs on a small scale, analogy suggests should also occur on a larger one.

Having thus shown that cosmical collisions are necessary events with such a system as the galaxy has been proved to be, I shall attempt to show that, except in the collision of bodies of very different volumes, complete collision is of extreme improbability, or, in other words, that almost all considerable cosmical impacts will be partial collisions. If we suppose two bodies of very great mass, and of excessively minute volume, collision can only occur when by their motions the two are tending to occupy the same point in space at the same time. In most other cases the bodies will tend to take hyperbolic orbits with a common focus, hence they escape each other. Suppose each to retain the same mass, but the volume of each to be expanded beyond the common focus, collision is of course inevitable, and it is clear that the impact must be partial. Those parts of each which lie in each other's path will mutually destroy each other's motion, whilst the remainder of each of the two bodies will pass on in orbits more curved than before, but which may still be hyperbolic; or, if the original proper motion of the bodies were small, or the part struck off of large mass, the new orbits may be elliptical, and one or both of the parts will return and remain in permanent orbits, as double stars. I may mention that I have already demonstrated, I believe, with sufficient clearness,

that the mere work of shearing the bodies when they come into impact, is such an excessively small fraction of the total energy, in cases of large masses, that it may be absolutely disregarded. As the whole of this reasoning holds good for all cases of the collision of approximately equal large bodies, it becomes evident therefore that these collisions are partial.

There is, however, one exception, that where the larger body extends so as to include the smaller body completely in its path. The impact in this case is complete as regards the small body, and tangential on the larger, and although tending to produce rotation possesses none of the definite properties of partial impact. It is clear that collisions may vary from the mere graze of the atmosphere of the two bodies, through the stage of cutting off a considerable ratio, up to the extreme case of complete impact, all of which possibilities tend to vary the result. Again, the two bodies may be intensely hot, or one hot and one cold; either or both may be solid, liquid, or gaseous, or mixtures of these physical conditions. They may have an original rotation of their own, and may have smaller bodies revolving around them. They may have had very different original proper motions, and may be of considerably different mass. Any of these peculiarities tends to alter the result attained at and after impact. Still, on the other hand, there are many broad well-marked generalizations which are sufficiently characteristic to mark out these partial collisions as a clearly defined genus, the phenomena resulting from them being easily recognizable to a skilled observer.

The accompanying diagrams probably represent with some degree of accuracy the stages of a medium case of partial collision. I have attempted to draw these diagrams from independent reasoning on dynamical principles, and have consulted others as to the accuracy of the reasoning. I must acknowledge my indebtedness for several valuable hints from Mr. N. K. Cherrill. The first figure (*Pl. VI.*) shows two bodies coming into impact—it will be seen that the bodies are distorted to an egg shape. The idea of this distortion was first suggested to me by Mr. Beverly, of Dunedin, who has been studying the various mathematical problems of complete cosmical impact for more than a dozen years. It will ultimately be found, when this question is discussed in detail, that this distortion produces some very interesting phenomena. The two following figures show the process of impact, and it is perfectly evident, from the mode of impact, the rare outside of each body meeting with the denser inside of the other, that the two sides of the coalesced mass have a great deal of unbalanced momentum, acting in different directions, and tending to spin the mass on its centre. It is generic of partial impact that it must produce rotation. It will also be seen that this same residual motion, and the attraction of the retreating masses, tend to draw the mass into a spindle shape. It is also evident, all



To illustrate PARTIAL IMPACT, Article IV.

Prof: Bickerton, del.

J.B. lith.

motion of translation being originally in the plane of the paper, that all motion but heat motion and original rotation will still tend to occupy that plane, and that it is consequently the plane of the rotation of the mass. According to the modern theory of heat, all those parts, whose motion of mass is destroyed, will have an equivalent heat energy given them.

Here I approach one of the striking peculiarities of this theory. For the temperature developed will not be in any way dependent on the proportion struck off. It will depend upon the molar velocity destroyed, and this, again, chiefly upon the mass of the attracting bodies, and the nearness of their centres of gravity. Thus the merest graze will develope nearly as high a temperature in the coalesced part as though one half of each were struck off. But in these two cases the gravitating powers of the coalesced mass are altogether different, and hence, in some cases, where a small ratio is struck off, the molecular velocity may carry every particle away into free space, and, in other cases, where the collision is more complete, the great attractive powers of the body may hold the gaseous mass in a definite position. I need not refer to the fact that the former case is typical of temporary stars, and the latter of nebulæ of definite form. On reference to fig. 4, it will be seen that the wounded retreating stars are considerably heated in and about the plane of section. On escaping the influence of the other bodies they would recover their sphericity, exhibiting a very highly-heated part on one side. I hope, in a future paper, to bring before the Institute a number of facts and conclusions which, I believe, will actually demonstrate that in these bodies we recognize the variable stars which stud our galaxy. It is powerful evidence in favour of this theory, that many variable stars are in pairs. In figure 5, the arrows show the general tendency of the motion in the several parts of the spindle-shaped mass of heated matter. I need scarcely mention that the mass in this form is a figure of a large number of the characteristic nebulæ, such as the nebulæ of *Andromeda*. In figure 6, the rotation of the centre of the mass has begun to give itself a spiral form, and an almost exact figure of Herschel's drawing of the nebulæ of the Lion is produced. The other figures trace the later possible phenomena which the various motions may produce. They represent systems of bodies, spiral, annular, and planetary nebulæ. I again state, that these figures were geometrically drawn on a well-considered estimation of the probable residual motion and attractions left in the mass. When some discussion has elicited all the difficulties which beset the question, I hope to offer you an approximate geometrical demonstration of the problem. I believe, however, that it is only in the impact of rare bodies, such as nebulæ, that nebulæ showing a spiral reaching near the centre could be produced.

In addition to the rotary motion in the plane of the paper, it will be seen that, from the distribution of the attractions and of the matter, pressure due to developed heat will act at first chiefly in a line passing through the centre of gravity and perpendicular to the plane of the paper, so that doubtless, in the majority of cases, a considerable proportion of gaseous matter will be found at the extremities of this axis. There appears considerable evidence that this is really the case with nearly all the ring nebulæ. But more careful investigation is needed on this point, as the drawings of different observers show considerable difference in this respect. It is certain that in the visible Universe nebulous matter lies chiefly at the poles of the galaxy.

But the heat-motion acts in another way in addition to mere pressure. Heat is caused by the motion of molecules, and this motion tends to give an outward direction to the whole mass of the gas. This motion tells most in the lighter molecules, so that when any particle leaves its fellow, it proceeds directly outwards away from the mass. This action, in many cases, would doubtless convert the whole into a mere spheroidal shell, and it is extremely probable that this is the condition of the planetary nebulæ. But whenever the ratio, struck off at collision, is large, or there is a large ratio of heavy molecules present, these latter return again and form the star so often seen in the centre of these bodies. It would be worth while for members to consider a variety of the many cases which partial impact offers. A particularly interesting case is offered in which an impact is so considerable that the escaping parts are mere shells, doubtless this would break up, and strew the spiral with stars. And again, as regards the problem of the subsequent state of the ends of the spindle, a careful inspection will show that the forward velocity is very different on their two sides, doubtless tending to cause them sometimes to separate into a number of rotating masses, giving rise to multiple systems, having the peculiarity so characteristic of the motion of our Solar System.

Thus it appears that rotation, matter chiefly in one plane, and high temperature proportional to mass, are the most striking general properties in partial impact, but that the many modifying causes may sometimes produce spirals or ring systems, in other cases mere gaseous shells, or in other cases densely-crowded systems, or complete dissipation of the whole matter into space. In fact, the field of possibilities appears nearly infinite.

I think I have shown that it is almost certain that partial impact is at once the most frequent of definite cosmical phenomena, and at the same time a most powerful constructive agent in producing the many marvels which the monster tubes of the great astronomers have shown to exist in such endless variety in the heavens.

ART. XV.—*On the Genesis of Worlds and Systems.* By Prof. A. W. BICKERTON, F.C.S., President of the Philosophical Institute of Canterbury.

[*Read before the Philosophical Institute of Canterbury*, 3*rd April*, 1879.] *

AFTER much consideration, I have decided to depart from the custom of giving a general view of the advance of science, feeling that the stupendous strides of the last few years are more fitting a course of lectures than a short address. I shall therefore devote the time at my disposal to one branch of science, viz., astronomy, which, from our occupying the southern portion of the globe, is one of the few physical sciences which possess local interest.

A new country, with its strange fauna and flora, is the naturalist's paradise. But the isolation, the want of differentiation in his studies and laboratory work, must ever render it a desert to the experimental physicist. The impossibility of ascertaining fully the progress of any branch of science by the few intellectual rays which reach so far from the focus of intelligence, will also tell in preventing much original research. But of course locally characteristic natural phenomena, if any exist, form an exception to this rule. This is the position of stellar astronomy: a circle of the heavens is hidden from the view of the great men of Europe, and, as it happens, a circle singularly rich in phenomena, containing, as it does, that magnificent region of the galaxy about the Southern Cross and the two Magellanic Clouds.

It is true that the harvest of this work was reaped by Herschel with his great reflector at the Cape. But there is still work for the gleaner, and in a large field of research it may be considered that his observations were only seed sown, the harvest of which may be reaped by future observers—I refer to all those phenomena in which the effect of time gives the chief interest.

As the study of astronomy has thus an undoubted claim upon our consideration, I shall not apologize for offering to you a brief account of a new cosmical hypothesis which has occupied a considerable portion of the Society's time lately. An hypothesis which appears to offer a possible explanation of many of the more peculiar among celestial phenomena. It certainly suggests many definite fields of astronomical research, the results of which, even if unfavourable to the hypothesis, cannot fail to be of value to science.

To the mathematician, also, it offers many novel problems. In fact, if this theory should attract attention so far as to pass into that first stage of success as to be called fallacious in principle, impracticable in detail, and absurd on the face of it; or, better still, should it succeed so well as to promote rational discussion worth answering, or obtain that highest eulogy the world knows how to give—of being discovered not to be new, it is probable

* President's Anniversary Address.

that the problems it offers will be fertile ground for the new calculus of vectors to take root in and expand itself, for both are apparently just fitted for each other.

This being a popular gathering, I propose giving a rapid sketch of the progress of astronomy and its present position, especially of the phenomena which this theory purports to link together and bring under the domain of recognized scientific law. This will also enable the extension of our ideas, which the theory suggests, to be better understood. I need not tell you that this sketch must be a very hasty one, as from the opposition which has generally attended progress in astronomy, every step would require much space to discuss it fully.

It is certainly not now necessary to demonstrate that the Earth is not the centre of the Universe, although we all know the amount of prejudice and obstruction which had to be overcome to get even this much admitted. But the whole view of the Universe and the utterly insignificant position the Earth occupies in it has been achieved only by very hard steady work, in the face of the most virulent opposition, and probably even now some would not be prepared to concede all the ground claimed by astronomers.

Nor need we wonder at this. It is natural for all of us to think more highly of anything which immediately concerns us than it probably deserves. and it is necessarily the peculiarity of ignorance to intensify this failing, The stay-at-home resident of a small town grows up thoroughly convinced that it is the undoubted centre around which the world revolves, and for which the metropolis exists as a place for the supply of the town's necessities, and although the disputes of the terrace and the square render it doubtful as to the exact position of the axis, yet the broad fact of its local existence is never questioned. So, the untravelled mind sees in the sun, moon, and stars, ministering lights, having the sole office of rendering this earth a fit habitation for man. But occasionally, amidst the long ages of almost brute-like stupidity, periods of enlightenment have occurred, when men have thrown away this garment of egotism—have looked beyond mere self, and tried earnestly to gauge man's place in nature. Thus we find Democritus teaching that the milky way was a belt of stars. Aristarchus showing the Greeks that the Sun is the centre of the system, and the Earth and planets revolve round it. Eratosthenes measuring the size of the globe and placing meridians and parallels on its surface. Then again, for many ages the cobbler stuck to his last, the practical man to his wooden plough, and the scholar to his traditions. No speculative theorist disturbed the calm, and gradually the world again became flat, and men's ideas stale and unprofitable. But, after many centuries of this hybernation, Tycho Brahe, Kepler, Galileo, led on by Copernicus, with the insane folly of

visionaries, neglected their business, and again went star-gazing. Many others followed the pernicious example of these unpractical dreamers, until the long succession of such lunatics, and the wonderful method of their madness, impelled even the most stolid to look for themselves, and then the astonishing discovery was made that men were not entirely composed of pocket and stomach. In fact, that unless development were to proceed backwards, and the tail again manifest itself, intellectual food was perhaps as essential as corporeal. In this way, after many efforts, the human mind has escaped its leading strings, has travelled, and seen on what a vast scale the Universe has been constructed; has gauged the Sun and seen him to be a million times larger than the Earth, and the millions of stars, suns like himself; has seen the earth sink into a small particle of cosmical dust of insignificant dimensions, compared to even the visible universe.

But do we think less highly of the earth for these extensions of our ideas? Certainly not. Like the travelled man returning to his boyhood's home, it is true the church spire may have lost its relative grandeur and altitude, and he no longer looks in his back garden for the earth's axis, yet he loves the place none the less, and finds the brook as clear and the wild flowers as fragrant as when he left; with all kinds of poetic essences diffused around everything, which it never would have had without the wider knowledge he has brought back with him.

So, whilst the Universe has been made to reveal its myriads of blazing suns and systems of suns, the Earth has unfolded to our eyes an endless diversity of treasures, and thus at once an infinity of massive grandeur and an infinity of detailed beauty have been simultaneously discovered.

But astronomers tell us that among the myriads of ordinary stars or rather suns which form the milky way, there are many erratic members and many bodies altogether unlike the general order. Some ten thousand stars are such close pairs that they appear to form twin suns, sometimes each of the twins have still smaller suns revolving round the larger one. In some places the stars appear so thickly spread that to the naked eye they are mere specks of mist, but the telescope says they are clusters of suns. Over a hundred stars appear to be altogether abnormal in their properties, shining with varying intensity at different times, and at some of their bright periods shining much more intensely than at other times. Quite like a modern belle going through regular short cycles of brilliancy, as each day rolls on, and, like her also, having, as it were, London and country seasons, for, after going through long periods of brilliant dress and undress, it gradually sinks into humdrum country life, scarcely even dressing for dinner. In fact the vagaries of variable stars are so extraordinary that they appear without any law or order; but, as Mrs. Grundy rigidly regu-

lates the apparently giddy proceedings of society's neophyte, so it appears possible on this new hypothesis to show that all this apparent stellar disorder conforms to laws as completely as the most carefully watched young lady.

Besides these variables which have been long out, it occasionally happens that a star blazes forth before the astonished gaze of beholders, and for a time monopolizes all attention. But after a little while, sometimes only a few weeks, sometimes a year or so, this meteor-like sun gradually loses its brilliancy, and passes away altogether, or becomes a very insignificant little star; the temporary star having no longer any existence except in history. The celestial temporaries have one advantage over our earthly stars, they are sufficiently rare that it is seldom any one is cut out by the appearance of a rival. Two of these stars have however appeared within the last twelve years.

But there appear several reasons to suppose that there is quite another class of stars, modest retiring suns, of altogether an unobtrusive character. Suns which have put up their shutters, and retired from business. Suns with very little vitality, or perhaps altogether dead suns.

In addition to all these varieties of stars there is a very wonderful class of bodies called nebulæ. These are delicate luminous clouds, probably consisting of masses of glowing gas. Some of them are of very definite structure, spherical, spindle-shaped, spiral, comet-like, and frequently strewn all over with brilliant stars. Some of them are so large that the size of our whole Solar System would be hardly a sufficient unit to measure them with. Most of these nebulæ are spread out in two sheets covering a large part of the celestial sphere at the poles of the galactic circle.

As in the human family so with the stellar inhabitant of space, many are associated into well-marked groups; as we have families, tribes, nations, and the whole race, so we have our solar family, our multiple star-system, and probably, by the recent researches of Proctor, the whole visible heavens is a definite and connected system, consisting chiefly of a vast ring of stars, with nebular caps at both its poles.

All of these bodies appear to be moving indiscriminately about, without common direction or purpose, although certain pairs and groups seem to have considerable community of motion. But they move fast in those celestial regions, they quite out-do our Canterbury snail ways, a thousand times as fast as our fastest railway train is only a walking star, and I feel afraid to tell you how fast some can run. And every star is pulling hard at all its near neighbours. The nearest star to our sun must have a velocity of sixty miles an hour to escape the sun's attraction.

But amidst all this flying about, this indescribable hurry, these powerful attractions, surely you will say there must occasionally be collisions. The

hypothesis I am about to describe suggests that this is the case, but especially says further, that if they do knock against each other the blow may be a mere graze of the two outsides, or sometimes a large piece of each may be struck off, and in extremely rare cases they may meet fair; but as this latter is so extremely rare, the other cases are those chiefly considered, and so the theory is called *Partial* Impact. I shall now try and show you what a perfect Aladdin's lamp of possibilities this theory possesses.

A gentleman who was present at a bombardment told me that he had seen the cannon balls strike pieces off the cannon and travel on in space. But the energy of each particle of a star at collision is hundreds of thousands of times greater than in a cannon ball, so the stars also will strike a piece off each where they strike one another, the remainder passing on in space. The proportional resistance to motion produced by impact in the escaping parts, would be thousands of times less than if a cannon ball of butter just grazed the top of an iron wall; in fact, the large pieces not coming into collision will be certain to travel on. So the effect of the collision of our two stars will be to strike a piece off each other where they touch each other, and each star will travel on, with a slice cut off its side. The parts of each which met will be left behind by both the retreating bodies, and will probably remain where the collision occurred. But, owing to the way it has been struck off, the two sides being impelled in opposite directions, it cannot help revolving, and it is not unlikely that nearly all the thousands of rotating bodies and systems in the Universe may have thus been set spinning by partial impact. At least, although we do not know what other agencies may ultimately be found to be capable of producing rotation, at present indirect impact seems to be the only one known.

Everyone, now-a-days, knows that heat is a kind of motion, and that ordinary motion destroyed, produces heat. An axle, screw, or gimblet—without grease—gets hot if quickly used. A rifle bullet makes a flash of light on striking the target, and often melts. A particle of matter plunges into our atmosphere and becomes so hot that it forms a shooting star. A school-boy takes his caning, and speaks of it as a warming. We rub the little cold hands of the wee ones who have been playing with the snow, and we stamp our feet when the thermometer sinks below zero. So if stars come into collision they will develope heat in the part struck off as striking a flint and steel strikes off a spark. In fact, our two stars may be considered as flint and steel meeting one another, striking off a spark, and passing on in space. Any student of heat will tell you that if the motion of a piece of iron be destroyed, he can calculate the temperature produced, if he knows its speed, and that the heat does not depend on the size of the

iron, only on its velocity. So when our dead suns come into impact, the temperature will not depend on the size of the spark cut off, only on the velocity destroyed. But if the piece cut off be small, it has but little attractive power to keep it together, and the particles are so hot—or moving so fast—that every single molecule flies completely away and disappears into space. Does it not look extremely likely that here we have our temporary stars, bursting forth when the collision occurs, and disappearing when its particles travel away into space? It certainly appears very likely.

But what about the two large pieces (the two wounded stars); a slice has been cut off each, and the hotter interior exposed; friction has also developed heat, and so when they become round again they will be hotter on one side than on the other. As they revolve they must almost certainly form a variable star, and the struggle of the two rotations will make this variation pass through long cycles, just as a spinning top oscillates if it has a kick. But as it would seem that two variable stars must be often produced together, the lists were searched to see if any pairs could be found, and a chart has been made from Chambers' list, and it shows sixteen well-marked pairs, or thirty-two connected stars out of one hundred and twenty. Unless we suppose this spotted condition to be a disease and catching, it is difficult, except on this view, to account for the pairs. Not only do we thus find these pairs existing, but some variable stars are close to the places where old temporary stars formerly existed, and also variable stars have become ordinary stars, as we should expect them to do when the temperature became uniform; and doubtless when the whole are carefully matched, many will be found to be gradually approaching the state of uniformity exhibited by ordinary stars. But it is not necessary to suppose thate th piece struck off each should always be such an excessively small ratio as to be projected into space, although the temperature produced by the collision will be almost always high enough to make gas of the coalesced part. This part may have mass enough to remain a permanent nebula. In this case reasons have been urged that render it probable that at first this gas would tend to take a spindle shape. Afterwards many possibilities present themselves according to the varying circumstances of the collision, for it is perfectly evident that these may be very numerous indeed. As the bodies may vary from cold dense solid bodies to rare masses of hot diffused gas, they may originally be moving very fast or very slowly; they may have been spinning with great velocity or hardly rotating at all; they may be nearly the same size, or a very unequal pair; and it does not need a Newton to see that any of these states will influence the result attained at collision and afterwards. The only effects which appear absolutely certain to follow partial impact are that rotation must ensue, that the matter will tend to

spread out more or less in a plane, with frequently gas at the poles, and that the middle body produced by the collision will generally be very hot, proportional to the mass.

In the papers presented to the Institute, the possible conditions of impact under which the different kinds of nebulæ may have been produced have been discussed. Thus it is suggested that the spiral nebulæ may have been produced by the collision of two previously existing nebulous masses, otherwise it appears that the extreme pressure would have destroyed the central part of the spiral. Singularly enough these nebulæ are found in the nebulous portion of the celestial sphere. Such evidence as this gives great probability to this theory. It is suggested that the comet-like nebulæ are masses with a high resultant velocity; that the planetary nebulæ are gaseous shells produced by the outrushing gas leaving the position of impact, and travelling outwards in every direction into space. Reasons based on the dynamical theory of gases have been urged why the heavier chemical molecules should return, and form the star which is very often seen at the centre of these bodies. Anyone who has followed this speculation must see that if this theory does represent the birth of nebulæ, they must be changing their shape, and sometimes new ones will be formed and old ones die out, and this is really the case. They vary; many new nebulæ have not only been found, but some have disappeared again, and many that used to exist are lost.

But such mere gas as nebulæ must not be allowed to detain us. There are far more solid matters to be discussed yet. Thus it has been suggested that the Solar System is not the kind of family Laplace has pictured it, with the Sun as the parent and Neptune as the eldest brother, down to the youngest, Mercury, or perhaps Vulcan. But it implies that the whole system are twin brothers and sisters, all born together; a deserted family whose severed parents are wildly travelling space. The collision which gave the Sun its heat gave it its rotation, threw off the masses which became planets, set these spinning also, giving them their accompanying masses of cosmical dust we call moons. That same great whirl set all the planets travelling in orbits all in the same direction, and nearly in one plane. The theory also attempts to show how the elliptical orbit became nearly circular;—how the original rotation of the two colliding masses would disturb the exact symmetry of the rotation of the planets. It attempts to account for many things too numerous to speak of here. But you will say the Solar System could not have been born in two different ways. Well, hardly. Then you must dispose of Laplace's nebular rings. Perhaps so; but even Laplace's theory demands a rotary nebula to start with, and it would therefore still seem that he needs partial impact to

provide him with that. But I will tell you, in confidence, that although we have not dared yet to put it in black and white, yet, in our discussions, we have even hinted that Laplace may have been altogether wrong, and have whispered many, many reasons, on modern views of energy and the dynamical theory of gases, why we think so. I will tell you one. According to Laplace, the surface of the nebulous sun should go on getting faster and faster as ring after ring was thrown off; but, as a matter of fact, the sun's energy of rotation is only one fifty-thousandth part of that necessary to throw off a ring, and those among us who believe in the conservation of energy, ask, where is that energy gone? It is thought possible that not only may bodies thus be set travelling around the central mass, but that frequently the resultant velocity left in them may carry them quite away from it altogether. It is suggested that possibly the comets and shooting-stars which illuminate our sky may have been thrown off at the birth of temporary stars or systems, and as they travel through space come accidentally into our Solar System, and are sometimes kept within it by the retarding action of an approaching planet, or by some other cause. Almost certainly they were not born with the Sun and planets; for, of all the comets observed, as many go against the direction of the planets as with it, so we really must consider the comets as foreign intruders, and as such treat them with the contempt they deserve. But you will say millions of millions of meteorites strike the earth each year;—exactly, probably scarcely a stellar collision has occurred which did not strew space with millions of homeless particles left to wander recklessly through space, until they met destruction at the hands of some pitying cosmical shark, who sympathized with them in their loneliness and so took them in. But if there is so much dust flying about space, it must interfere seriously with our view when we look at very distant objects, as muddy water is opaque if deep. Struve held manfully to his opinion, based on good evidence, that distant light did suffer extinction; and does this not appear to offer a very good reason for thinking he was right?

But other things may be said of our two wounded stars—flint and steel—whom we left travelling in space. We have seen how a spark was struck off which became a temporary star, a nebula or a system, according to circumstances. We also suggested that flint and steel might become a pair of variable stars, getting more and more distant from each other. It is possible, however, if their original proper motion were small, or if they had much cut off them, that they may return again and form a connected pair, and add another to the many twin suns already existing. It is suggested that probably many of these became connected in this way. It is known that some binaries are variable. It is possible that these stars may come into

collision a second time, and, even as an extreme possibility, more than twice; and it does not appear unlikely that this is really the case with Tycho Brahe's temporary star. There is one thing that makes it likely. All the text-books speak of it as a possible variable with a period of 313 years. Now, it appeared absolutely certain that if such a thing as consecutive collision did happen, it would be longer between the first pair of impacts than between the second pair of impacts; and, on taking the dates given by Herschel, it was found that the first interval was 319 and the second 308 years, thus adding another to the very remarkable series of coincidences which have been found in working out this hypothesis.

But people are never satisfied without trying to ride a hobby to death; and really it does seem going rather to extremes to suggest, as has been done, that nearly all we see in the heavens—all the millions of suns, all the nebulæ—are parts of one great system produced by the impact of two stupendous bodies meeting in free space—a system so extensive, that it would probably take light at least a hundred years to pass through the mass; while of the bodies themselves, some are so big that the number of times our sun would be required to measure their volume must be reckoned by thousands. Thus has the hobby been goaded on, and it is not absolutely certain that it has thrown its riders yet. It is true Proctor has been for years carefully laying down a veritable railroad for just such a hobby; when he was working out his great research on the visible universe, so that it was easy work for it, it ran like a snowball down a hill, gathering speed and proportion as it went. But I must tell you how Proctor did this work. He collected statistics of the number of stars and nebulæ, of star-clusters and star-motion. He and his friends placed all these on charts, and when they were finished, a single undoubted system was seen, which he describes roughly as a ring or spiral of stars, with our solar system at or about the centre, and with two caps of nebulæ covering the poles of this ring. So when the picture of the visible universe, given by Proctor, came to be examined, it was found to be so like that which had been suggested as likely to result from "partial impact," that it was felt the visible universe itself must be one of its numerous offspring.

But what does such an idea of the origin of the universe suggest to our mind of the contents of space generally? Clearly, that if two such bodies, why not many, some almost infinitely large compared to them? Why not go with Kant, and think that as the earth and its moon are part of the Solar System, as this system is part of the galaxy, why not the galaxy a part of a still more imposing system? Anyhow, the idea of space, suggested by this theory, is that it contains an infinite number of masses, varying in size from the particle of hydrogen to the stupendous mass which physicists look forward to as the final condition of the visible universe.

Of all the speculations of modern thought no two ideas have obtained stronger hold upon the human mind than the indestructibility of matter and of energy. But although energy is indestructible, it is generally supposed it will pass into an unavailable form, and although matter cannot be lessened in quantity, yet it is believed it will all be aggregated into one stupendous mass. Consequently our great mathematical physicists look forward to a time when any motion but heat will be impossible, and all life will be extinct. Yet this dreary, this repugnant conclusion, has apparently been the only possible result that could happen from any of the standpoints from which the laws of nature have hitherto been viewed. It is no small recommendation that the theory of "partial impact" offers a possible mode of escape from this melancholy prospect. It suggests that if gravitation does aggregate and tend to drain space, impact produces dispersion. Everything moves more slowly at a distance from an attractive source, so if bodies are moving indiscriminately in all directions, it is clear that where they move most slowly, they will certainly congregate together, thus tending in the opposite way to gravity, and in this way may be kept up a more or less uniform distribution of matter in space. The theory shows that the radiated heat of the sun falls upon the cosmical dust, which shuts us in as a curtain, and it is thus prevented from being lost; it also shows how, from various reasons, we must suppose that inconceivable numbers of particles of cold gas are slowly travelling space, and as these particles touch any part of this heated matter, it uses the heat of the body to project itself at increased velocity into more distant regions of space, there perhaps helping to build up new bodies capable of carrying on anew all the wonderfully complicated functions which matter and energy are playing in the visible universe. In this way we hope that this theory will remove these repulsive blots of dissipated energy and aggregated matter, which deface the otherwise fair and stately structure reared by modern science, so that the intellectual cravings of the human mind may find in it the invigoration and rest which they require.

Thus, the entire picture this hypothesis presents to the mind is that of a Cosmos, infinite and immortal. In it a being travelling through eternity, on the wings of light, would see as little permanent change as does the sea-bird over the restless ocean. He would sometimes be present at the nativity of galaxies, see solar systems in all stages, see suns absorb planet after planet, each time flickering up for a few thousand years, and finally, after having devoured all its family, shrink smaller and smaller, and then become less and less brilliant, until the last faint glimmer had died out, and a vast cinder is all that remains of that former scene of teaming life and brilliant beauty. Then he might watch the approach of dead suns,

and see, Phœnix-like, new suns arise from those cold masses of ashes, and as he watches the amazing flash of the collision, he may see flights of comets and meteors emerge from the flames and start on their long journey. Travelling on, he may see worlds absorb their enveloping nebular curtains, see others solidifying. In some, witness the garment of organized life gradually extending itself and clothing the surface with vitality; and should he stay to take a detailed look, he would probably sometimes see forms of life so strange, so weird, that the animated engines of Erewhon would be commonplace compared to them. Is it possible that in some white hot body he would see viscous silicon building itself into complex protoplasmic molecular skeletons, developing organ after organ, and breathing forth its halogen breath? Perchance he might watch a silicon monster tenderly waiting on a sickly friend, and feeding it with delicately-flavoured molten flint broth. But methinks I hear someone whisper, "I thought so. Undoubtedly he is mad." So, remembering the fate of Solomon de Caus, and being desirous of retaining my liberty, I conclude by thanking you for the attention with which you have listened to me.

Art. XVI.—*On the Birth of Nebulæ.* By Prof. A. W. Bickerton, F.C.S., President of the Philosophical Institute of Canterbury.

[*Read before the Philosophical Institute of Canterbury, 3rd July,* 1879.]

In the following paper I propose to discuss the generic methods by which nebulæ may be produced; and also attempt to show how the various kinds of nebulæ, of definite structure, may have had their special form given them.

The word "nebulæ," in this paper, will not apply to all gaseous bodies. Thus the Sun is not improbably gaseous, but of such density as to give a spectrum broken only by dark lines. On the other hand, I have shown it is extremely probable, that all space is filled with more or less diffused gas, not dense enough to be considered a nebula. I shall apply the term to bodies rare enough to give a bright line spectrum, and dense enough to be visible in the telescope, or to be associated by gravitation.

Nebulæ may be formed by the aggregation of very diffused gas, by the volatilization and diffusion of dense masses, and by dense masses passing into diffused gases, being there volatilized and attracting gas towards them.

The conversion of dense bodies into nebulæ is probably chiefly effected by impact, as already suggested by Croll and others, but I shall attempt to show that the ordinary idea of *complete* impact cannot play such an important part as "partial impact." I have already shown, that the partial

impact of approximately equal bodies has a far higher probability than complete impact, and also that, cosmically, partial impact has a far higher constructive capacity.

I wish to state that I do not mean, that between unequal bodies partial impact is more frequent than complete. It is certain that the impact of particles of gas upon a body such as our Sun, must practically always be complete. Mr. Beverly has made a calculation of probabilities on the best assumption of the conditions of space attainable, and he finds that in all bodies having a greater ratio of diameter than 6 to 1, complete impact is more likely than partial. That when the equality of diameter is nearer than 6 to 1, partial impact is more likely. Therefore, as an impact of any bodies, whose diameters show a greater ratio than this, is an absolutely insignificant cosmical event, unless one of the bodies had a stupendous proper motion compared to its size, the matter may be thus considered to be placed on a mathematical basis. In calculations relating to the energy of bodies formed from diffused gas, it is impossible to talk of their total energy, as such energy is indefinite if we only consider the body as becoming infinitely small, and it is clearly impossible to say how small a body (such as our Sun, for instance) may become. I have therefore found it much more convenient to treat of the potential energy converted into other forms of energy, which I call "changed potential energy." I believe it to be a mistake to suppose that very highly-diffused gas, having a definite limit of volume, is necessarily hot. It appears to me, that if the gas be so much diffused that its surface-attraction is very small—that it must be cold, or dissipating into space. There are four different lines of reasoning which point to the conclusion, that as a nebula or gaseous sun gets smaller, it gets hotter. I shall therefore assume that cold, infinitely diffused, disassociated gas, possesses a maximum energy.

Students of kinetics will readily be able to prove that were our Sun twice its present mass and twice its diameter, the energy of attracting a particle from infinity to its surface, without initial motion, would be exactly the same as at present. It can also be shown that such a Sun has lost exactly as much potential energy in forming itself from diffused gas as two such Suns as our own Sun. Therefore, were two such Suns as ours to come into impact, coalesce, and expand, until the whole of the heat of the collision were used in expansion, then the new Sun would have twice the mass, twice the diameter, one-fourth the density, and the same temperature as that of either of the original bodies. Thus it may be seen that two gaseous Suns attracting each other from infinity, without initial motion, were they to produce one Sun at the same temperature, it would only be twice the diameter.

There are reasons to believe that this point of equality of temperature is also a stable condition. Of course, the original suns were in a state of gaseous equilibrium, and as the density of the new Sun is one-fourth of each of the original, and the surface is just four times as great, hence the surface-pressure is one-fourth, and the density one-fourth, the temperature being the same, clearly, according to Marriot's law, this is a stable condition. This would, doubtless, be absolutely true, were the bodies homogeneous, but, as I have shown previously, there is every reason to suppose that "selective escape" would ensue, and would slightly alter the final result. Thus it is proved that the complete impact of equal bodies, without initial motion, will not produce a nebula (disregarding "selective escape"). But a matter of great importance to other parts of the theory is shown here. An impact tends to lessen density, consequently the density of very large masses may reasonably be supposed to be much less than that of smaller bodies. When the available energy of the visible Universe, on the supposition of its formation by partial impact, comes to be considered, this may be an important point.

It is easy to show that in the complete impact of bodies of unequal size the possibility of forming a nebula is still smaller; hence, as it is certain that the complete impact of bodies, without original proper motion, cannot much more than double the diameter of a star, it is clear it cannot produce a nebula, unless the mass were almost nebulous before. Of course, as the final result of an immense number of complete impacts, without loss of energy, a nebula might be produced, and this would be greatly aided by any proper motion any of the bodies might possess. In complete impact, with an original proper motion of a few hundred miles a second, two bodies like our Sun would be converted into a nebula; such an impact, it appears to me, would produce a roughly-spherical nebula without rotation. To produce rotation, it appears that the impact must be either partial, or between unequal bodies. To produce a nebula of definite form, other than spheroidal, appears to demand the same conditions.

In the partial impact of two bodies having a proper motion sufficient to take the two bodies away from each other after impact, nebulæ of various kinds may be produced, as the coalesced part struck off from the two bodies may be of very small mass; yet the velocity at which the two bodies would pass each other would be very great, hence the amount of changed potential energy may be enough, and more than enough, to completely diffuse the coalesced mass into space as gas, and clearly intermediate conditions may make nebulæ of every degree of density. Having shown that partial impact has energy enough to form diffused nebulæ, the kinematic possibilities will be discussed in the origin of special forms of nebulæ.

In my paper on the Visible Universe,* I have given reasons to show that possibly the whole of the galactic poles consist of more or less diffused nebulous matter. As the reasoning, upon which I based this conclusion, appears to have been too condensed to be readily understood, I will give it a a little more in detail. Suppose the plane of the paper to contain the orbits of the two impacting bodies; when during the impact the centres of the two bodies are at their nearest point, it is probable the gaseous pressure produced by the impact will be near its maximum. It is certain that this pressure can only cause an escape of gas in a plane perpendicular to—and bisecting—the line joining the two centres of the two spheres. But the chief part of the material left by unbalanced momentum will be in the intersection of this plane and the plane of the paper, hence the only direction in which the pressure can act will be in a direction perpendicular to the plane of the paper. But this direction is the same as the axis of the resultant rotation due to the impact, and perpendicular to the plane in which the general mass of the matter will be distributed (which is clearly the plane of the paper). After the central mass has become free from the two bodies, the pressure will act in all directions, but the gas extended during the impact will more or less continue the direction it has taken, and will, doubtless, to a large extent separate itself from the other portions. As its direction will be perpendicular to the general movement, the polar nebular caps, and not unlikely all annular nebulæ which accompany the galaxy, were probably so formed.

Having thus shown that the poles of the milky way were probably at one time covered with diffused nebulous matter, I will discuss the mode in which aggregations may be formed. It appears certain that any very large cosmical bodies would have myriads of bodies travelling around them in all orbits. In the case of the two large bodies which formed the Universe, it would, therefore, probably be so likewise. Many of these bodies would be entrapped by the outrushing gas, and would be carried with it in its journey. The gas would also meet the bodies already existing in the portion of space through which it travelled. At first, the temperature would be so high that the smaller bodies would certainly be heated and volatilized, but would render the mass more or less irregular, and these irregularities, if very considerable, would tend to increase themselves. The larger masses might form permanent nebulæ; in some cases, these would ultimately become stars. As the nebulous mass became colder, a peculiar selective action would not improbably tell upon it. If the temperature of the mass be uniform, the velocity of mean-square of the molecules of the several chemical elements will be inversely as the square-root of these molecules' weight. A body travelling through this mass may have sufficient attractive

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* *Vide ante*, Art. XIII.

powers to collect up the slow heavy molecules, but not the lighter ones, and again the lightest molecules may have velocity enough to gradually escape the mass. Thus, the gas left would only be the intermediate molecular weights.

It is a peculiar coincidence that many nebulæ give only a few spectral lines as though of a single gas, and that gas in some cases nitrogen, an intermediate weight. It is somewhat singular that *lithium* and *rhodium* should not be seen in these nebulæ, unless these elements should be cosmically rare. In some cases the temperature may, perhaps, be below that of dissociation of the compounds of these elements, and they may be chemically combined, and their compound molecules may be heavy enough to be picked up by attraction. The star of 1866, before it faded, gave a feeble continuous spectrum with apparently the lines of nitrogen, as though selective escape had acted in such a way that the heavy molecules had become dense enough to produce the continuous spectrum, all the hydrogen had escaped, and the nitrogen was forming a nebula. Thus it appears, that in a large diffused nebulous mass we may have aggregation by original irregularities ; and also by bodies passing into the mass and being volatilized, then gradually aggregating the denser molecules arround it. Finally, these may become stars, the hydrogen may escape, and the nitrogen may be the only part left in a sufficiently gaseous state to give bright lines.

It does not appear impossible, that a mass of gas may be at too high a temperature for dense aggregation, and may be orbitally connected, and the free molecules may be revolving around the central mass, the nucleus gradually picking it up as its velocity was lessened by loss of heat by radiation, or the velocity diminished by impact, or its direction so changed as to impinge upon the central mass.

Having thus glanced at the various generic modes of the origin of nebulæ, I will shortly discuss their spherical forms and the mode in which they may have originated ; but I shall not enter too much into detail, or give any lengthy demonstrations, until I have laid the whole of the broader generalizations before the Institute.

Nebulæ are roughly divided into resolvable and irresolvable nebulæ, according as to whether the telescope can resolve them into stars or not. They are distinguished by their forms into—

Nebulous stars
Spherical nebulæ
Spindle ,,
Spiral ,,
Cometary ,,
Planetary ,,
,, ,, with nucleus.
Annular ,,

The roughly-spherical nebulæ are by far the most numerous in the heavens, and are chiefly found distributed at the poles of the galactic circle. It is probable that most of these, and also many nebulous stars, may have been formed by volatilization of bodies passing into heated gas, or by aggregation, in the manner already described. Some may have been formed by impact, either complete or partial. But it is in studying the nebulæ of definite forms other than spherical, that the peculiarly striking capacity of partial impact to explain phenomena of the heavens becomes apparent.

The spiral nebulæ have been probably formed by the partial impact of bodies already existing as nebulæ before the impact. The forms of the spiral nebulæ were probably at first spindle-shaped, but as the chief part of the ends of the spindle would belong each to its respective original body, its motion would be directed outward, whilst the inner parts would be in a state of rotation. This would gradually convert the whole into a spiral, or rather a double spiral. Every gradation from a spindle-shape to a spiral are to be found in the heavens; there are spindles showing no signs of spiral, some as in *Leo*, showing the incipient spiral in the centre, and others in which the spiral is very perfect, and others, again, in which the coils of the spiral appear to have passed into a roughly spherical nebula. In the earlier discussions on the origin of the forms of these bodies considerable difficulty was experienced in understanding how a spiral nebula could have been formed, as it appeared that the extreme pressure of the central mass of the gas must tend to destroy all the spiral structure, especially at the centre of the nebula. When, however, the idea of the impact of previously-existing nebulæ occurred, all the difficulties were removed. But it is evident that if spiral nebulæ were formed by the impact of nebulæ, they would not be found in the galactic circle with the planetary and other nebulæ of regular shape, but at the galactic poles with the general mass of spherical nebulæ. On looking upon a celestial globe this will be found to be the case. I am aware that much discussion has recently taken place as to the existence of these nebulæ, but it seems almost impossible but that some impacts producing them must have taken place, so that not only do I believe that their existence will be clearly demonstrated, but that many of the spherical nebulæ, when carefully examined, will be found to be roughly spiral, as Proctor has demonstrated the Universe to be. Probably some of the double nebulæ are at present in a state of impact; if so, their form ought to alter materially during a single generation.

I do not imagine that the spindle-shaped nebula is confined to the impact of rare bodies. It appears to me that all partial impacts will tend to produce a spindle-shaped body at first; this matter is fully discussed in a paper on the general problem of stellar impact.* The shape may be re-

* *Vide ante.*

tained until a spindle nebula of considerable dimensions is formed. It is not difficult to account for the origin of cometary nebulæ. These have donbtless been formed by an impact in which a want of balance in the momentum left a considerable residual velocity in the nebula, and that as it travels it becomes smaller, both by losing the hotter and more volatile portions, and by its own condensation.

The planetary nebulæ have always been considered the most wonderful objects in the entire heavens. The Herschels devoted much time to their discussion, and in my opinion conclusively proved them to be self-luminous hollow spheres of most stupendous diameter, several of them being many times larger than the most of our most distant planets. Recent spectroscopic observations have proved them to consist of gas; so that the problem before us is—to account for gigantic slightly-luminous hollow spheres of gas many thousand millions of miles in diameter.

Supposing we have an immense crowd collected in one spot, and that each one begins to move on indiscriminately in a straight line, and each if striking against anyone goes on again in the direction the blow has started him, and all continue to move straight on indefinitely: it is certain that in a few days the spot where the crowd was will be clear, and an immense irregular circle of people will exist, and will constantly be extending itself. This I believe to be the condition of a planetary nebula; an impact has taken place; on grounds of probability it was most likely partial; but the physical conditions would be nearly the same were it a complete impact of bodies with a stupendous original proper motion. As I have already stated, such an event appears to me, however, to be of amazing improbability. Either of these two suppositions will supply us with a gaseous body of such a high temperature compared with its mass, that every molecule will have sufficient velocity to escape the gravitating influence of the mass and travel straight on into space. For example: If a particle of gas at the surface of the Sun had a velocity of four hundred miles a second, such a particle would pass out of our system; and it is almost certain that had every particle this velocity—that is to say, the necessary temperature—the Sun would become a planetary nebula or a hollow shell of luminous gas. It is a remarkable confirmation of this theory, that Lord Lindsay has reported that the temporary star of 1877 has become a planetary nebula or a hollow shell of luminous gas. I have already shown how selective escape may have produced a nebula consisting of intermediate, or in fact any group of approximately equal molecular weights; and I need not say such reasoning applies equally to planetary nebulæ; the nucleus being in some cases the aggregated heavy molecules. These bodies are doubtless dynamically in an unstable con-

dition; if not of great age, they are probably increasing their diameter, which may continue until they diffuse themselves into space. If very old, they have probably reached their limit of size, and the molecules may have so far lost their velocity by radiation during molecular impact, and by work done against the gravitating influence of the mass, as to be on their return journey, and in the act of forming themselves into a condensed nebula, and finally an ordinary star. It is singular. It is singular that it is only in the galactic zone that planetary nebulæ occur, and it is clearly in this zone that the great distribution of stars would lead us to expect many impacts.

It appears possible to explain the origin of the annular nebulæ by partial impact in two different ways, and there may be representatives of both in the heavens, which will be found when the observation and classification of nebulæ are more satisfactorily done. In a former paper I have hinted at one of these methods, and the other explanation is the same as that given of the origin of the visible Universe, which would not improbably appear an annular nebula were it possible to see it at a sufficiently distant point in space (but which I have already shown, owing to the probable enormous distribution of small dark bodies in space, is unlikely,—as it is unlikely we see any distant universe). It appears that all annular nebulæ are more or less resolvable. There are many points of interest in connection with the origin of these small stars. Most of these have already been discussed in this paper in connection with the origin of nebulæ by aggregation; but probably almost the entire ring consists of those parts of the original bodies which were not very much affected by the impact as far as regards temperature, and much of this resolvable matter is not unlikely the dense, more infusible, part of the matter which very likely occupied the centre of the original bodies, and which was swept out into a circle, or rather two half-spirals, by the residual motion and attraction immediately after impact.

There is one point in connection with the origin of the very slight eccentricities of all bodies moving in elliptical orbits (which is probably the condition of some of these bodies in annular nebulæ)—such as many double stars, and the members of our Solar System, whose nature has hardly been sufficiently noticed. On first passing away from the central mass, their motion is such that their orbit would be highly eccentric, if there were no agencies at work tending to render them circular. I have already shown that there are many such, and I will attempt to make this point clear. Supposing the body to leave in advance of the general body of the gas, to travel to its extreme distance, return and plunge into the body of the gas, when it has gone some distance into the gas the attraction acting upon it

is clearly less than was all the material inside its orbit. If its original orbit had been such that, when at perihelion, it occupied such a position that, were it to return to the same place, on its return nearly all the matter would be outside its orbit, there would be scarcely any central attraction. Therefore, it would *not* come to that position, but must keep a long way from the centre; in other words, its orbit has become enormously more circular, or less eccentric.

I will only, in this paper, call attention to the enormous mass of evidence that is accumulating respecting the change of forms, and the sudden appearance and disappearance of nebulæ; proving that they are not distant universes, and also giving great probability to the theory of their origin, which this paper suggests.

Art. XVII.—*On the Doctrine of Mind-Stuff.* By Frederick W. Frankland.

[*Read before the Wellington Philosophical Society, 27th September*, 1879.]

The objects of the present paper are, to describe briefly a theory or doctrine of existence, expounded by the late Prof. Clifford, in an article "On the Nature of Things in Themselves," but arrived at independently by several persons—amongst others by myself, as far back as the year 1870,—and to propound and assist toward the solution of a series of problems which arise in connection with this theory.

The starting-point of the theory is the position, commonly associated with the names of Berkeley and Hume, that all the properties of material objects, as investigated by the physical and natural sciences, are capable of being analysed into possibilities of feeling, or relations among possibilities of feeling. Thus the redness of a rose is the possibility of a certain visual sensation, and the roundness of an orange is a complex of relations among the possibilities of certain visual, tactual, and muscular sensations. Granting this position, it obviously follows that every assertion of physical science—every assertion, that is, respecting matter, force, or motion—is merely an assertion respecting possibilities of sensation or feeling. The truth of this position is demonstrated by a process of self-observation or introspection, and must be verified by each individual for himself. It is believed by the present writer that the conclusion arrived at cannot be resisted by any mind which performs the requisite process of self-analysis with perfect precision and faithfulness.

The only concrete realities, therefore—the only "things-in-themselves" that we know of, are *feelings*. Psychology is the only concrete science. The word "feeling" is used here to denote any mental state whatever.

The feelings or mental states of which we have experience comprise the comparatively vivid ones known as sensations and emotions, the fainter copies of these, sometimes called "ideas," which constitute the material of which thought is woven, and certain unique states of mind which form integral parts of volition and belief—states of mind which assimilate most nearly to emotions, but which may be described as somewhat too colourless, if the term be allowable, to be fairly classed with these.

All the real existences we know of being mental states, the totality of existence falls for each individual into two sections: *his own* mental states, *i.e.* mental states which form a part of his own consciousness, and mental states *not his own*. The former constitute a stream or chain, extending from a past that is more or less remote into a future almost wholly unknown; his present condition of mind being a transverse section of the stream, or a link in the chain. His knowledge of the portion anterior to the present moment is obtained partly by the faculty of memory, and partly by a system of inferences; his anticipations as to the portion that is still future are grounded entirely on inference.

Now, by a process essentially identical with that by which he infers these future portions, and some of the past portions, of his own stream or chain of consciousness, each individual comes to believe, at a very early stage of his career, in the existence of other streams or chains of consciousness which are more or less like his own, but which are entirely outside it. He believes that his fellow-creatures are conscious beings, and that the higher animals are sentient. The process by which this conclusion is reached, and by which it may be justified, is fully described by Mr. Mill in a well-known passage of his "Examination of Sir William Hamilton's Philosophy." There is a further inference drawn which is of great importance, and which I hope will engage our attention in a future paper. The inference is drawn that there exist relations of sequence and of synchronism between his own feelings and the feelings which compose the other streams of consciousness. These relations had already been recognized among his own feelings, and might easily be inferred as existing among the feelings of any other one stream of consciousness taken by itself. But it might seem a more perilous step to infer cross-relations of this kind between *different* streams; nevertheless, this inference, endorsed every hour a thousand times by the common sense of mankind, is one which I think can be shown to be logically justifiable. Without, however, dwelling any longer on this point, we may note that each individual conceives of other streams of consciousness as running parallel to his own in Time, and that their *outsideness* to his own consciousness is quite a different thing from the apparent outsideness of any material body. A material body, or, as it is usually called in

the language of metaphysics, an *object* (even if it be the farthest fixed star) is an abstraction the primary reference of which is to a concrete something *inside* the individual's consciousness, namely a certain group of his own sensations; while its appearance of externality is derived from the fact that it also refers to actual or possible sensations *outside* his consciousness, namely in the consciousness of other beings who do or might exist. These *other streams of consciousness*, and not the earth, air, and sky, are the true "External World" to each individual. The outsideness or externality of these "other streams of consciousness," of which each one among us infers the existence, and of the feelings composing them, appears to me to be very happily expressed in the term by which Prof. Clifford has proposed to denote them, namely the term *eject*. The minds of my readers are "ejects" to me, and my mind is an "eject" to them. The use of this term also places in marked contrast the genuine outsideness of these inferred existences with the pseudo-externality, so to speak, of the material universe.

So far, nothing new has been enunciated. The thinkers of the school to which I belong, maintain that, paradoxical as some of the above assertions may sound, (for instance, the denial of the concrete existence of matter,) the common sense of mankind will bear us out in them, if only its deliverances be analysed and formulated with precision. It is only when we take a further step that our doctrine parts company with the belief of the uninstructed. This further step is taken in answer to the question: "Are there ejects which form no part of any consciousness? Are there non-personal ejects?" and to the further question: "If so, what is their nature?"

Are there ejects which form no part of any consciousness? In other words, besides the consciousnesses of intelligent beings, each with its rich phantasmagoria of sensations, and its varied wealth of ideas and emotions, are there any real existences? My readers will immediately reply, "To be sure. There is the earth, with all the material objects on its surface, there are the sun, moon, and stars, and, in fact, the whole material universe?" This, however, would be a reply which would not meet the question at all. For, as indicated in the first portion of this paper, if any one will honestly examine the nature of his conceptions respecting material objects, he will find that they resolve themselves wholly into conceptions of possibilities of sensation in himself and in other sentient beings who do, or might, exist: and, if all these possibilities of sensation be abstracted, he will be much puzzled to attach a meaning to the assertion that there is a residuary existence behind. It will not suffice, therefore, to answer the question by merely affirming the existence of a material universe: we must also state whether we believe that, *besides* the possibilities of sensation, and the relations

among these, which constitute the whole content of physical science, there exists a universe of realities inaccessible to physical science, on which the possibilities of sensation are dependent. In the language of metaphysics the question may be thus stated :—Does the *phenomenal* world, or world of appearances, correspond to and depend for its existence on a *noumenal* world, or world of realities, wholly outside us ? The answer given by the majority of metaphysicians is, I believe, that there does exist such a world of realities, but that its nature must be for ever hidden from us.

Physical science, they would say, investigates the properties of things *as they appear to us*—investigates the *outsides* of things, so to speak ; but things *as they are in themselves,* the inner nature or *insides* of things (though we may be certain of their existence, whether intuitively or as a result of legitimate inference), are inaccessible to human research. This I take to be the doctrine of Kant, and also the doctrine of Herbert Spencer. Now, the doctrine I wish to describe this evening, is partly in agreement with the foregoing doctrine, and partly in disagreement with it. There *is* a universe of realities, it affirms, underlying the phenomena which it is the business of physical science to investigate, but its nature is *not* wholly unknown to us. For let us consider a particular section of physiological phenomena—the phenomena of the human brain. In the changes which take place, during life, in the grey matter of the brain, we have a field for physical research. These changes belong to the world of phenomena—to the world of "things as they appear to us." They may be described in the language of physical science, and statements respecting them would resolve themselves, in last analysis, into statements of possibilities of sensation, and relations among those possibilities, in the mind of a supposed observer. But now, according to both the doctrines we are considering, this complex of phenomena—this group of changes in the grey matter of the brain—must have a complex of noumena, or "things-in-themselves," underlying it. What is this complex of "things-in-themselves?" It is not an object of physical research. Physical research stops at the changes in the grey matter of the brain—stops at a group of *appearances.* What is the complex of "things-in-themselves" which underlies these appearances ? Now we know, or at least have very strong ground for believing, that some of the changes in the grey matter of the brain correspond to feelings or thoughts in the mind of the person to whom the brain belongs. *According to the doctrine of Mind-Stuff, these feelings or thoughts are the noumena—the "things-in-themselves"—which underlie the changes in the grey matter of the brain.* What *appears* to an outside observer—or rather, what would appear to him, were the skull transparent, as a change in the grey matter of the brain—*is* in reality a feeling or thought in the mind of the person to whom the brain

belongs. This feeling or thought is not an object of physical research. It belongs to the world of noumena, or "things-in-themselves," with which physical science has no concern, or with which it is only concerned in so far as the hypothesis of the existence of such a world is required to account for that world of phenomena, the laws of which it is the business of physical science to investigate. Thus we see that in regard to at any rate one part of it, it is not true to say that the noumenal world is veiled from us. We know it by introspection ; and we know it as feeling or thought. We are ourselves—our minds, I mean, not our bodies—strands in the web of the noumenal world ; and therefore, although no part of that world can ever be investigated by physical science, we see that a portion of it forms the subject-matter of subjective psychology, and is consequently not altogether unknown to us. Of course it is only *one's own* consciousness which one knows with any great precision. I do not know whether the sensation which my neighbour calls green is qualitatively quite the same as that which I myself call green. The phenomena of colour-blindness demonstrate conclusively that in some cases it is not. Still, I have, in a general way, an acquaintance with the consciousness of my fellow-creatures and of the higher animals. They constitute the portion of the noumenal world which we obviously know something about—something which physical science could never tell us.

And now, what are we to say about the rest of the noumenal world—the remaining strands of the web ? There *is* a remaining portion, for we have agreed that there *are* noumena or realities underlying the phenomena of inorganic and of non-cerebral organic nature. What are these realities like ? Now, the doctrine of Mind-Stuff asserts that these realities are made up of the same *stuff* or elements as the human mind, only that the elements are combined together in a less complicated way. The universe, according to this view, is a stupendous web of mind-stuff, the elementary strands of which are ever weaving themselves into new patterns from eternity to eternity. The most complex of the compound strands are the minds of intelligent beings, and from these there is every degree of complexity down to the elementary strands themselves, which correspond to the motions of inorganic matter. Whether the elements of the noumenal world are described as being themselves feelings, or only as the elementary constituents of feelings, appears to me to be merely a question of language. If we adopt the former phraseology, the doctrine may fitly be called that of *Omnisentiency.* This was the name given to it by a former fellow-student, Mr. William Boulting, now a member of the medical profession in England, and myself, when we arrived at it, independently but almost simultaneously, in the year 1870. Although it appears that we have been anticipated by

Professor Wundt, the eminent German physiologist, and perhaps by others, we may claim as much originality as any of the exponents of the doctrine, and priority over most.

I now turn to some of the problems which are suggested by the general theory of things we have been considering.

First: In what relation does the doctrine of Omnisentiency or Mind-Stuff stand to the various theories which have been propounded for explaining, on the principles of rational mechanics, the phenomena of the physical universe? In what relation does it stand to the theories of atoms, ether, ultramundane corpuscles, ring-vortices, and the like? Now, in the first place, it does not either exclude or supersede them. There is nothing in the doctrine of Mind-Stuff incompatible with any of these mechanical theories. The theories in question are one and all of them statements of quantitative relations among possibilities of feeling, and are not in any way concerned with the noumenal realities on which these possibilities depend. The universe of matter is a complex of possibilities of feeling, and these possibilities are found to stand in certain quantitative relations to one another. These relations are of two orders,—relations of sequence and relations of co-existence. The former are believed to depend, without exception, on causal relations—relations spoken of as the *laws of nature;*—the latter are space-relations, and may be described as *facts of structure.* All the mechanical theories I have alluded to, therefore, and indeed all mechanical theories that can be framed, are affirmations either of mechanical laws or facts of structure, or both. Setting out from the relations of sequence and facts of structure which we *observe* to exist among the possibilities of sensation which constitute the material world, the physical investigator does one of two things. He either infers, by a complete induction, the existence of such and such causal relations, and then deduces facts of structure which are not capable of being observed; or, he *assumes* the existence of certain facts of structure, and perhaps also of certain causal relations, and shows that by *known* causal relations these will lead to the observed facts of structure. In the former case, his process is one of scientific demonstration, in the latter he constructs a scientific hypothesis. To the former category belongs the reasoning by which we infer that matter consists of molecules (in other words, that its structure is discontinuous), and that there is an ether; to the latter, belong such hypotheses as those of ring-vortices and ultra-mundane corpuscles. But now, observe, we are throughout dealing with quantitative relations among abstract possibilities. The whole of mechanical science deals with such relations. It is in no way concerned with the inner qualitative nature of the real existences on which these possibilities depend. These real existences are aggregations of Mind-Stuff.

Psychology is the only science which deals with them; and even that deals only with the most complex of them. Therefore the Doctrine of Mind-Stuff can in no way supersede the necessity of, still less can it exclude, these mechanical explanations of the universe.

But although the principles of rational mechanics, and the hypotheses by which, in conjunction with the former, it is sought to explain the observed phenomena and structure of the material world, are in no way in conflict with our doctrine, we shall presently see that they may come to have a very important bearing on the determination of the particular form which that doctrine ought to assume. For the doctrine asserts that the possibilities of sensation which constitute a material object, correspond to, and depend for their existence on, some reality outside us or "eject" of which Mind-Stuff units are the elementary constituents. Hence every conception of mechanical science must denote what would be called in mathematics some *function* of Mind-Stuff. Matter, defined as that which has mass or inertia, must be a function of Mind-Stuff. Motion, force, and energy, must be functions of Mind-Stuff. The interesting question then suggests itself: *What* functions, severally, are mass, momentum, energy, etc., of the noumenal reality which we have designated Mind-Stuff. This question has been touched upon in a profound passage of the late Professor Clifford's review of a work entitled "The Unseen Universe." Professor Clifford there indicates that the answer to the question, if it *can* be answered, must depend on the knowledge we can gain respecting Mind-Stuff itself—knowledge which can only be acquired within the domain of psychology. Our feelings, he points out, have certain relations of contiguity or nextness in space, exemplified by contiguous elements of a visual image, and certain relations of sequence in time, exemplified by all feelings whatever. "Out of these two relations the future theorist must build up the world as best he may. Two things may, perhaps, help him: there are several lines of mathematical thought which seem to indicate that distance and quantity may come to be expressed in terms of position, in the wide sense of an *analysis situs*, while the theory of the curvature of space hints at a possibility that matter and motion may be expressed in terms of extension only."*

* I take this to mean, that if we admit as a possibility that the properties of space may show a sensible divergence from the Euclidean standard, if we consider very small parts of it—we get at a way of defining matter in terms of the space which it occupies. An ultimate atom of matter (perhaps infinitesimal as compared with the chemical atom) would on that view be merely an infinitesimal crumple in space. All physical science would then be reduced to transcendental geometry, and space-elements would be the analogues of Mind-Stuff units.

The former parts of Professor Clifford's suggestion can only mean, as far as I can

Now it is my ambition to follow out the line of thought here indicated. It would be impossible to do so fully within the limits of a single paper, but a beginning may be made. In the first place I desire to supply what I conceive to be a serious omission in Professor Clifford's enumeration of the data respecting Mind-Stuff which the "future theorist" has at his disposal. Feelings not only have relations of contiguity or nextness in space, and of sequence in time, but they also have two other quantitative aspects of very great importance, namely *degrees of intensity* and *differences of volume.* We are conscious that sensations differ in intensity; thus an acute pain is felt to be a more intense sensation than a faint smell. Also, we are conscious that sensations of about equal intensity differ in something we call *volume* or *massiveness:* thus a sensation of general weariness, though perhaps felt to be of about equal intensity with a particular ache, is distinguished (apart from its *qualitative* difference) as possessing greater mass or volume. Lastly, we know that there exist *causal relations* among our feelings. Thus the group of ideas* characterized as the realization of a danger is followed by the emotion of terror, and the constancy of the sequence indicates that we have here to deal with a causal relation. Hence the data we possess are these:—a complex of feelings perpetually undergoing transformations, causal relations between successive feelings, relations of contiguity or nextness among a few of the synchronous ones (though this appears to be an exceptional phase of psychic structure, only to be found, as far as I am aware, among simultaneous visual impressions which co-exist in a space or manifoldness of two dimensions), qualitative resemblances and differences, variations in intensity, and variations in volume or mass. These are the materials from which we must construct our conception, save as to certain spots necessarily a very dim one, of the noumenal world. And these are the materials which we must connect, in the best way we can, with the elementary factors of our conception of the world of phenomena. We must endeavour to establish a correspondence between feelings, their causal and topical relations, their intensities and volumes, on the one hand, and the dynamical conceptions of mass, momentum, force, energy, etc., on the other. Now, as a preliminary to the working out of this correspondence it will perhaps be advisable to take a brief survey of the ultimate dynamical conceptions, and of their relations to one another.

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see, that space may be not only not homogeneous in ultimate structure, but not even infinitely divisible. It may consist of indivisible units. In that case there would be such a thing as absolute magnitude, and measuring would be reduced to counting. The space-unit would then be the analogue of the Mind-Stuff unit.

* An idea is merely a combination of derivative feelings which are severally faint copies of more vivid primary feelings. In the present case there is included also an unique element called *belief* alluded to in an earlier portion of this paper.

Our first step will show us how thoroughly interdependent all these conceptions are. *Matter* can only be defined as that which possesses *inertia*—as that which requires a *force* proportional to its amount (designated its *mass*) to effect a given change in its *motion* (either a change in velocity, or a change in direction, or both) in a given *time*. *Force*, again, can only be defined as that which causes a change in the velocity or direction of the *motion* of *matter*. It is tacitly assumed, though not often expressed, that the only thing which can cause such a change in velocity or direction is the co-existence of other matter. This amounts to saying that force is a relation of co-existence between different portions of matter. But every relation of co-existence in the material or phenomenal world is a relation of mutual position in space. Hence force is a relation of mutual position between different portions of matter. *Motion*, in the kinetic, or dynamical, as opposed to the merely kinematical sense, is a change in the position of *matter*, and is completely determined when the mass of the moving body and the kinematical conditions of the case are given. The notion of *energy* does not require the introduction of any fundamentally new conception. Hence the phenomenal world is accurately described if we speak of it as a complex of motions, varying in infinite ways as regards mass on the one hand, and velocity and the other kinematical aspects on the other, tending severally to constancy in all these respects, but having a mutual action on one another, determined by their relations of co-existence, and, therefore, undergoing perpetual transformations. Now mark the parallelism. The noumenal world, we have seen, may be described as a complex of feeling-elements, or Mind-Stuff units, having, just as motion has, extension in Time, varying in infinite ways as regards volume, intensity, and quality or timbre, having a mutual action on one another, determined by their mutual relations of co-existence, and undergoing perpetual transformations. Is this parallelism something more than a parallelism? Without attempting to justify it in this paper, I would hazard the conjecture that motion *is* Mind-Stuff, that volume of feeling *is* mass, and intensity of feeling velocity. Professor Clifford seems to have believed that motion and Mind-Stuff were identical, and indeed to have held the belief in a much more dogmatic form than I should be inclined to do; but the other two identifications are, as far as I am aware, quite new. The degree of light which cerebral physiology may be capable of throwing on the question must be estimated by abler minds than my own: but one implication of my hypothesis has struck me as favourable to it. *If matter in* MOTION be Mind-Stuff, it follows that if matter were ever at absolute rest, it would no longer correspond to any noumenal existence. It would become a pure abstraction—one term of a product, the other term of which was zero. Does not this appear in harmony with the hypothesis of Sir Wm.

Thomson, which makes all the atoms of ordinary matter, and all the particles of which the ether is composed, to consist of a rotational motion in an incompressible frictionless fluid? The stoppage of the vortex-motion would be the obliteration of both atoms and ether—the annihilation of the sensible universe. The perfect fluid *at rest* would be, on my view, a mere nullity. No noumenal existence would correspond to it, and it would, in fact, merely represent the potentiality of massiveness among feelings.

Two other identifications will at once suggest themselves, and may be relied on with greater confidence than any of the three preceding ones: First, the causal relations among elements of feeling will have their counterparts in the causal relations among motions of matter, *i.e.*, they will have their counterparts in the dynamical laws of the universe. And secondly, the relations of synchronism among elements of feeling will have their counterparts in the relations of synchronism among the motions of matter, *i.e.*, they will have their counterparts in the space-relations of the universe. Certain passages in Herbert Spencer's "Principles of Pyschology" seem to indicate that he entertains a similar belief.

And now, one more thing follows. The nexus of causation which obtains among the feeling-elements, or Mind-Stuff units, *i.e.*, among the elements of the noumenal world, must be at least as complex as the corresponding nexus which obtains among the motions of matter, *i.e.*, among the elements of the phenomenal world; *and it may be indefinitely more so.* For the phenomenal world depends for its existence on the noumenal world, and is in fact only a particular aspect of the latter—that aspect, namely, which the noumenal world presents to its own most complex strands, the percipient beings that grow up in its bosom. Nor can the elements of the phenomenal world derive any complexity from the interaction of the noumenal elements which they represent with the complex structure of the precipients. For it is the especial triumph of the mechanical theory of the universe to have eliminated all these complexities, and referred the affections of the various senses to the same source. Thus the sensations of light and warmth we receive from a fire, are both referred to the radiant energy of the ether which intervenes between the fire and ourselves. Hence we may be certain that the nexus of causation in the noumenal world is at least as complex as the dynamical nexus of the phenomenal world. *But it may be indefinitely more so.* There may be many causal relations in the noumenal world which have no types in the phenomenal world, though we may be certain that every dynamical relation in the phenomenal has its anti-type in the noumenal world. The phenomenal world is a *projection*, so to speak, of the noumenal world on the plane of observation, and much complexity may be lost in the process of projection. In the same way the space-relations of the pheno-

menal world must be paralleled by a nexus, at least equally complex, of synchronous relations in the noumenal world. But the complexity of the latter may be *greater* by any amount than that of the former. There may be facts of structure in the noumenal world which have no representatives, so to speak, in the world of phenomena. It has always seemed to me probable that this was the truth which Spinoza had in his mind when he said that extension was only one out of a perhaps infinite number of attributes possessed by the universal substance. The possibility in question shows that there is nothing in the doctrine of Mind-Stuff *per se*—Professor Clifford to the contrary notwithstanding—to negative the belief either of the spiritualist or of the theologian. It may or may not be the tendency of physiological research to exclude the conceptions with which these two classes of thinkers are concerned, but this exclusion can certainly not be the result of an acceptance in its most general form of the doctrine here described. On the other hand, there is equally little in it to encourage or lend assistance to theological belief. The proposition that there is a dim quasi-sentiency pervading the world, is as far removed as possible from the proposition that there are *intelligences* unconnected with any brain, and this latter proposition, which is the essence of all spiritualism and theology, can derive no support from the former. In regard to theology, then, the doctrine of Mind-Stuff is neutral. It may rather be described as *monistic* than as materialistic. It affirms that there is only one Existence—that which Herbert Spencer* speaks of as the "Substance of Mind"—and that the supposed dualism of matter and spirit is an illusion.

ART. XVIII.—*A Reply to Mr. Frankland's paper on "The Doctrine of Mind-Stuff."* By C. W. RICHMOND, a Judge of the Supreme Court of New Zealand.

[*Read before the Wellington Philosophical Society, 1st November*, 1879.]

MR. FRANKLAND'S paper,† as suggesting a Monistic theory of the Universe, is in entire accordance with a prevailing tendency of thought amongst physical philosophers. To close the long contest of Spiritualist with Materialist by cancelling the difference between *mind* and *matter* appears to many persons at the present day an enterprise of which the ultimate success is certain. "One substance," to quote the words of Professor Bain, "with two sets of properties, two sides, the physical and the mental—a double-

* To a hint thrown out in the concluding paragraph of Mr. Herbert Spencer's chapter on "The Substance of Mind," I feel that I owe the suggestion of the doctrine.

† Art. XVII., *ante*.

faced unity—would appear to comply with all the exigencies of the case." Such thinkers are not seeking to bridge over a supposed chasm between mind and matter, but are denying that there exists any gulf to be crossed. To those, on the other hand, who hold that the antithesis between mind and matter is indestructible, every attempt to identify the spheres of Subject and Object, the External and Internal worlds, must needs appear a futile undertaking. In the view of Dualistic Philosophy, the two spheres are separate as regards, alike, the essential nature of their contents, and the organs and modes of observation whereby they become known to us. Our knowledge of mind is derived from self-consciousness; our knowledge of matter from perceptive observation of the external world. Whilst the phenomena of matter are referred by us to Time and Space, mental phenomena are referred to Time alone; nor can the attempt be made to attribute extension to any purely mental experience without violating the conditions of thought, and lapsing into nonsense. Finally, whilst Mind appears essentially active, and mental experience is the source of our ideas of *cause* and *force*, the conception of Matter, of necessity, includes the notion of *inertia*.

The Monistic theorists of the present day affect, and no doubt desire, to take a firm and indifferent position on the fulcrum of the balance; but they fail—so at least it seems to their critics—to secure a truly central stand-point, and thus come sliding gently down the beam into the scale of Matter. Berkeley, who is followed by Mr. Frankland through the earlier portion of his paper, whilst he denied to us any knowledge of the external world of matter, affirmed (as a fact known to us more surely and intimately than any other) the existence of Mind. Hume went beyond Berkeley, denying to human knowledge the existence of both entities. He is to be considered as the immediate progenitor of the modern Phenomenal School. The modern Monist may seem to follow Berkeley for a time, but it is soon evident that minds trained in the school of physical research cannot endure a lengthened sojourn in the thin region of Idealism. It may have seemed that they were on the point of merging Matter in Mind. But, habit and training are strong with them. Their pretension to apply to mental phenomena the methods of analysis and computation which have served them in the field of Matter, makes it evident that their speculation has resulted—according to their own apprehension of its consequences—not in the resolution of Matter into Mind, but in the merging of Mind in Matter.

That this is really Mr. Frankland's position seems apparent from his very choice of a name for his doctrine. It would be difficult to find a term more thoroughly materialistic in its associations and suggestions than this of "Mind-Stuff." If there could be any doubt about the writer's real

tendency, it is removed by the proposal to transfer to the description and investigation of mental phenomena such notions as "mass," "motion," "velocity," "momentum." To me, I confess, the proposal appears destitute of possible meaning. The notion of extension is obviously involved in every one of these terms. In our "matter-moulded forms of speech" all these ideas are applied metaphorically to spiritual existence, and the things of the pure intellect. But we are conscious of the metaphor. We speak of a massive intellect; but would not gravely affirm that Cuvier's understanding weighed precisely 64 ozs. Because we talk of "a rapid intuition," we do not suppose ourselves able to compute, in terms of space as well as time, the speed of those glances of the mind compared with which "the tempest itself lags behind, and the swift-winged arrows of light." The Materializing School, in treating of the emotions, in which our bodily frame co-operates with our mental constitution, often make use, with marked predilection, of language properly applicable only in the field of Physics,—and we hear continually of "waves," "currents," "vibrations," and the like. But into the proper region of the intellect they do not venture on importing the idea of space. Professor Bain, in his "Compendium of Mental and Moral Science," recognizes, *in limine*, the grand division of human knowledge into the two departments of Matter and Mind,—or, as he prefers to call them, Object and Subject. "The department of the Object, or Object-world, is," he says, "exactly circumscribed by one property, extension. The world of Subject-experience is devoid of this property."

Mr. Frankland adduces the sensation of general weariness as an instance of a mental phenomenon, involving the perception of volume or massiveness; which includes the idea of extension. But this is a physical sensation, and no instance of a purely mental experience. Our own limbs and body are as much a portion of the external world as any other part of it. Unquestionably the sense of weariness is always, more or less, definite in extent. We may feel our legs tired, or our arms and back, or tired all over. Just in the same way we recognize in sensation, more or less exactly, the extent of a wound or burn. To prove what is wanted, an instance must be found of a purely mental emotion or operation, unconnected with any corporeal feeling. But we are certainly not conscious of the extent in square surface, or cubic space, of our love, hatred, remorse, regret; or of any process or result of the reasoning power. To these, terms of intension, which are dynamical, not material, may be applied; but never terms of extension.

But I pass on to consider the validity of the induction—shall I call it, or the fidelity of the intuition—upon which the new doctrine is to be

founded. It is made upon the collation of the mental phenomena revealed to us by self-consciousness, with those physical changes in the grey nervous matter of the brain, which are, with great probability, assumed to accompany the mental phenomena. Let it be supposed that the observer voluntarily enters upon some train of thought—say, the asses' bridge in Euclid: it is assumed, and, I concede, with great probability assumed, that this mental process will be exactly represented by concomitant observable physical changes in the nervous substance. One may imagine observations of this kind brought to a high pitch of accuracy, so that any witness of the cerebral phenomena, in the case supposed, should be enabled to infer therefrom, with certainty, that the subject was in the act of demonstrating Proposition No. 5 of the First Book. In this and similar cases Mind takes—or seems to take—the initiative. We should, therefore, expect to find the thought slightly in advance, in point of time, of its material expression; or, at least, not posterior in point of time. In such a case Mr. Frankland seems to consider himself justified in inferring that the mental operations—the *noumena*, as he terms them—"*underlie*," or are even identical with, the physical appearances. These are his words:—"According to the doctrine of Mind-Stuff, these feelings, or thoughts [in the mind of the person to whom the brain belongs], are the *noumena*—the "things-in-themselves"—which underlie the changes in the grey matter of the brain. What appears to an outside observer—or rather, what would appear to him were the skull transparent, as a change in the grey matter of the brain—*is*, in reality, a feeling or thought in the mind of the person to whom the brain belongs."

I find it not easy exactly to define my own position with reference to this speculation. There is much in Mr. Frankland's essay with which I heartily concur. He appears to me, if I may venture to say so, on the verge of truths which will lead him in a philosophical direction diametrically opposite to that which I understand him to be now pursuing. To such positions as these—that there *are* realities which underlie appearances—that physical science can never reveal to us these realities—that Psychology alone can give us philosophical access to them—I assent *ex animo*. But I find it necessary to question the particular mode in which the writer proposes to make the transit from that which *appears* to that which *is*.

In collating the sequence of ideas in the mind with the concomitant medullary changes, we have, I submit, two parallel series of phenomena between which we are incompetent to conceive of any necessary connection. I presume that this will be at once admitted as true in regard to any two parallel series of physical phenomena. In the field of physical science we know only, that events follow one another in an invariable sequence. We are not entitled to affirm that the antecedent event causes, or produces, the

consequent. Our knowledge is limited to the fact that the phenomena always follow one another in the same order. The phenomenal philosophy disclaims cognition of producing causes. Its so-called causes are merely invariable antecedents destitute of originating power. It is needless to enforce this doctrine upon minds trained in the philosophy of Hume, the two Mills, Auguste Comte, Bain, and Herbert Spencer. A philosophy which limits knowledge to phenomena, cannot consistently admit any other opinion. But I am not employing their doctrine as a mere *argumentum ad hominem*. In the field of Physics, it is, I believe, an absolute truth.

In the case we have to consider, one of the two co-ordinated series of events is physical, and the other mental; one is within, the other beyond, the sphere of consciousness. Does this make it easier to supply a connection between them? It may be argued that the sense of spontaneity, or mental initiative, in the case of a train of thought voluntarily entered upon, entitles us to regard the "noumena" as underlying the "phenomena." That important inferences may be founded upon this sense of a mental initiative I certainly hold, but not the inference which Mr. Frankland suggests to us. His term "underlying" is somewhat equivocal. I do not think it can be understood in any way which will justify his doctrine of "Mind-Stuff." If, by the use of the term "underlying," it is meant to affirm that we are conscious that the mental processes *cause* the material—cause *i.e.* in the sense of producing them—I reply that we have no such consciousness. The cerebral phenomena are outside the field of consciousness; the mental outside the field of bodily vision. How shall we connect experiences which belong to different spheres and are made known by faculties of different order? We can do no more than note down the succession in time of each series, and mark their correspondence. Our experience, just as in the case of two parallel series of physical events, does not entitle us to affirm more than the invariable concomitance of the corresponding terms in the two series. The fact that the mental phenomena occur within the sphere of consciousness is no help to us. We cannot annex to them, still less identify with them, the series of physical manifestations. The changes in the nervous matter are wholly involuntary, have only recently been ascertained to exist, and remain to this hour unknown to and unsuspected by the mass of mankind. Psychology ignores them; and could we, as suggested, by some mechanical expedient be witnesses of their occurrence in our own frames, we should look upon them as something extraneous to ourselves. Their association with our mental constitution would make no difference in this respect.

A similar question has been much debated in a case in which there is greater reason for believing that we are conscious of Mind in action upon

Matter—I mean the case of the voluntary movements of our limbs. I determine to stretch out my arm, and the mental mandate is at once obeyed. But even here the nexus remains to us entirely mysterious. If I order a servant to bring in a scuttle of coals, and he does it, I am, in a sense, the cause of the occurrence. But that is only in a hyper-physical sense. There exists a sufficient physical cause in the contraction of my servant's muscles; which, again, involves the disappearance of an equivalent of heat in the combustion of his muscular tissues. The case is exactly the same in the instance of the movement of my own limbs at the bidding of my own will. Here also there is a physical antecedent—(a sufficient cause in the sense of the Physicists)—in the expenditure of my own bodily forces. The mental initiative is something outside (so to speak) of the physical series, and not connected with it in any way conceivable by the human intellect. I am here only asserting against Mr. Frankland the doctrine of his own teachers. "We are," says J. S. Mill, "the causes of the motion of our own limbs in the same sense, and no other than that, in which cold causes ice, or a spark causes an explosion of gunpowder." By this Mill meant, of course, that our volitions are mere antecedents, not producing causes of motion.* This is well-beaten ground; and whilst disclaiming the larger conclusions of the Positivist school, I have always thought it to be in the right upon this particular point. But if we are not justified in regarding a mental act as the *vera causa* of a voluntary motion, which we have exactly conceived and pre-adjusted, how much less is it allowable to posit a like act as the underlying cause of an unknown and unsuspected change in the cerebral matter.

The terms in which Mr. Frankland expresses his doctrine seem to warrant the interpretation I have been putting upon them, namely, that the "noumena" in the mental series are causes of the phenomena in the physical series; and my remarks have applied to the theory understood in this sense. But taking the paper as a whole, it is rather perhaps its true meaning that "noumena" and "phenomena" (if not identical) are common effects of a single cause, or motions of a single substance; the supposed cause, a substance, being within the circle of our own consciousness—being, in fact, in each man's case, his own mind—himself. To put it shortly: Thought and Cerebration are to be regarded equally as vibrations of our own self-conscious Substance; or even as one and the same vibration. From this is drawn the further inference, that our own self-conscious substance is a portion of the universal substance.

I have no right to press against Mr. Frankland the *dicta* of masters in the school to which he apparently belongs. As an independent thinker,

* See also "Hume's Life," by Huxley; p. 128.

he has, of course, a right to discard any part of their doctrine which he conceives to be unsound. But the disciple often finds himself involved, by a partial departure from the established creed of his sect, in unexpected inconsistency. With this preface, I wish to cite a few lines from Professor Bain's "Compendium" (*Appendix*, p. 98). After asserting that, "Everything that we know, or can conceive, may be termed a quality or attribute," he pertinently inquires, what is left to stand for 'substance ?'—and answers the query as follows :—"One way out of the difficulty is to postulate an unknown and unknowable entity, underlying, and in some mysterious way holding together, the various attributes. We are said to be driven by an intuitive and irresistible tendency to make this assumption; which intuition is held to justify us in such an extreme measure. There is an unknowable substance, "matter," the subject of the attribute inertia, and of all the special modes of the different kinds of matter—gold, marble, water, oxygen, and the rest. The same hypothetical unknown entity is expressed in another antithesis—the *noumenon* as against the *phenomenon;* what *is*, in contrast to what *appears*." Now, Mr. Frankland seems to think that in the particular class of experiences which he has selected he has evaded the difficulty insisted upon by Bain. Self-consciousness has given him entrance behind the scenes of external Nature which he can now contemplate *ab intrà*. He needs not "to postulate an unknown and unknowable entity," since he is himself the entity observed. In the co-related phenomena of intellect and brain he seems to recognize himself as self-conscious substance, simultaneously cognizant of his own being, of the material organism with which it is allied, and of the nexus between the two. This is his key to the enigma of the Kosmos. If I interpret him rightly, he has at all events emerged from Phenomenalism, and may be welcomed over by the Ontologists. Differing, as I do myself, from Professor Bain, I cannot here press his authority upon Mr. Frankland. In regard to the idea of "substance," Mr. Frankland is clearly at liberty to reject Bain's characteristic attempt to explain away a notion which human thought cannot dispense with, and will ever insist upon supplying. Nor should I quarrel with the application, to mind, of the term "substance," which is properly a metaphysical notion. The use of the term in theology is familiar. Spinoza regards God as a substance. But every argument which I have adduced to show that the cerebral changes are not effects of mental causes within our consciousness is also valid to prove that they are not accidents or motions of our own mental substance. This supposed substance is, be it remembered, *ex hypothesi*, a self-conscious entity, and could not be ignorant of its own vibration, or even of its own capability of vibration. Besides which, as I have already urged, the changes, or vibrations, are

demonstrably the physical consequents of physical antecedents. The chain of physical causation is complete in itself.

There is yet another defect, as it seems to me, which ought to be pointed out in Mr. Frankland's theory. It will not fit the case in which cerebral phenomena must be regarded as antecedents of mental; as in the instance of diseases and lesions of the brain, idiocy, and old age. If we suppose that, in the case of the voluntary exercise of intellectual power, mind may detect itself in action upon matter, it is equally true in the cases above suggested that the relation is reversed, and matter is found in action upon mind. The causal nexus must be affirmed in all cases, or rejected in all.

In any view of it, I prefer Mr. Frankland's theory to the naked materialism of Professor Huxley's essay on the "Physical Basis of Life." It is better, I mean more philosophical, to regard the motions of a man's brain as physical effects of his mind or will, than to reverse the supposed order of causation, and affirm, with Huxley, that mind is "the expression of molecular changes" in the protoplasm of the cerebral cells. I reject both opinions; but, in so doing, must not be thought to deny the obvious truth that the human mind is made manifest in and by a material organism. It is only through such an organism that we can communicate with each other. We need not seek, in the obscure, involuntary, and to us inexpressive, motions of the brain, for proofs of exact correspondence between the mind and the physical organism. In the face, voice, and eye of man, we have the familiar exponents of his intellect and soul. Cerebral anatomy, with its dark lantern, will never add a perceptible ray to the broad daylight of conviction in which we live upon this subject. As regards our undoubted command over these well-known indicia of thought and feeling, it is psychical, not physical; as I have already tried to explain in the case of voluntary movement of the limbs. Behind (so to speak), and beyond, the innermost nerve-centres, sits the Will, apart from the material apparatus; and its mandates are transmitted, we know not how, we know not why, by ways inscrutable to science, never to be laid bare by scalpel or dissecting-needle, to the corporeal agents. It is in vain, as Professor Bain points out, that we "insist on some kind of local or space-relationship between the extended and unextended." "A certain mystery," he admits, "has attached to the union of mind and body." The mystery, thus spoken of in the past tense, remains a mystery, and I believe will ever do so. Our minds are manifested in material phenomena, but are not themselves the causes of these phenomena; neither are they the effects; nor can any mental be identified with any physical event.

But, again, I must not be supposed to deny that mind, or, as I prefer to say, *a* mind, is the true ultimate cause alike of the human intellect and of

the organism with which it is associated, and as little, that we have, through Psychology, legitimate philosophical access to this fundamental truth. My remarks have been directed against the suggestion, that we ourselves, as self-conscious substances or agents, are the source of the physical phenomena associated with the exercise of our thinking powers; and against the doctrine which it is sought to found upon that suggestion; and I have purposely avoided, as far as possible, the collateral topics of controversy which are opened by the paper under review.

ART. XIX.—*Pronouns and other Barat Fossil Words compared with Primeval and Non-Aryan Languages of Hindostan and Borders.* By J. TURNBULL THOMSON, F.R.G.S., F.R.S.S.A., etc.

[*Read before the Wellington Philosophical Society*, 23rd *August*, 1879.]

THE following comparisons may be taken as supplementary to my last paper.* In that paper I confined myself principally to nouns expressive of roots of the several dialects or languages. In this one I have scrutinized the analogies of the pronouns, and some of the adverbs, also of a few nouns and verbs, which had previously escaped my attention. I must here again acknowledge my great obligations to the Hodgson lists, published by Dr. W. W. Hunter.†

My plan in this enquiry has been to bring the principal east and west Barata tribes in juxtaposition, and then to compare their *fossil words* with those of the old tribes of Hindostan and borders, as follows:—

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
I	izaho aho	aku ku	o a'u	au ahau	au wau owau

PRIMEVAL AND NON-ARYAN LANGUAGES OF HINDOSTAN AND BORDERS.

Sunwar, *go;* Thulungya, *go;* Bahingya, *go;* Dumi, *ang-gnu;* Vayu, *go;* Lepcha, *go;* Mithan Naga, *ku;* Abor Miri, *ngo;* Sibsagar Miri, *ngo;* Laos, *ku.*

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* Read before the Wellington Philosophical Society, and printed in Vol. XI., Trans. N.Z. Inst., p. 157.

† The works from which I have sought assistance in this paper are:—Comparative Dictionary of the Languages of India and High Asia, by W. W. Hunter, B.A., etc.; Marsden's Malayan Dictionary; Language and Literature of Madagascar, by Rev. Julius Kessler; Dictionary of New Zealand Language, by W. Williams, D.C.L.; Samoan Dictionary, by Rev. George Pratt; Hawaiiau Dictionary, by Lorrin Andrews.

Note.—It will be observed that in the five Barat races, the words standing for the first personal pronoun are radically the same. In Malagasi the first syllable is merely a prefix used before verbs, when emphatic. In the three Polynesian dialects the aspirate is lost, while in Malay the palatal *k* takes the place of the aspirate *h*. The radical in all cases is monosyllabic, *ho*, *ku*, *u*, *au*, *au*, the prefixes taking the form of *iza*, *a*, *o a*, *ah*, *w*, *ow*.

In the Continental races, analogues are found in the Nepal tribes, as *go*, *ang-gnu*; in the East Bengal as *ku*, *ngo*; and in the Indo-China as *ku*.

In the Malay language I have given the generic term only, the other words used for the personal pronoun I, such as *saya*, *beta*, *patek*, *hamba*, literally meaning slave, or *goa*, being vulgarly used in towns where the Chinese predominate.

It may be observed that the Javanese term conforms to the Malay one, to wit, *aku*.

English.	Malagasi.	Malay.	Samoan.	Maori.	Hawaiian.
Thou	hianao	angkau, kau kamu, mu	'oe	koe	o oe

Hindostan.

Thochu, *kwe*; Tibetan, *khe*; Serpa, *khyo*; Murmi, *ai*; Denwar, *tu-i*; Lepcha, *hau*; Kocch, *tu-i*; Annam, *maii*; Ahom, *mo*; Khamti, *mau*; Keikadi, *ninu*; Khond, *yinu*; Yerukala, *ninu*; Karnataka, *ninu*.

Note.—The radicals in use are *ao*, *au*, *u*, and *oe*. The prefix in Malagasi being *hian*; in Malay, *angk*, *kam*; in Samoan, a suppressed aspirate; in Maori, the palatal *k*; and in Hawaiian, the vocal sound *o*.

In the Continental races, the analogues of the Malay and Malagasi terms are found in Nepal, *khyo*; in N.E. Bengal, *hau*; in Indo-China, *mau*; of the second expression in Malay, to wit, *mu*—in Indo-China, *mo*; in Central India, *ninu*, *yinu*; of the Samoan, Maori, and Hawaiian—in Tibet, *kwe*, *khe*; in Nepal, *ai*, *tui*; in Indo-China, *maii*. The Malays use the word *lu* when addressing inferiors, and *tuan* when addressing superiors.

The Javanese term for *thou*, viz., *kowe*, is identical with the Polynesian dialects.

English.	Malagasi.	Malay.	Samoan.	Maori.	Hawaiian.
He	izi	deia eia	'o ia	ia	oia

Hindostan.

Horpa, *ja*, *jya*; Waling, *aya*; Denwar, *i*; Kusunda, *isi*; Dhimal, *wa*; Talain v Mon, *nya*; Annam, *a'i*; Ho (Kol), *a'i*, *a'io*; Kol (Singhbhum),

ini; Bhumij, *ini;* Mundala, *inni;* Tuluva, *aye;* Badaga, *ava;* Irula, *ava;* Malabar, *avan, aval;* Sinhalese, *ae, eka.*

The radical is *i-i* or *i-a*, the vowels in Malagasi being joined together by the sibilant *z*, in Malay being prefixed by the dental *d*, and the Samoan and Hawaiian being prefixed by the vowel *o*.

In the Continental races, the analogues of the Malagasi are found in Nepal, *isi;* in Indo-China, *a'i, ini, inni;* of Malay and the Polynesian tribes—in Tibet, *ja, jya;* in Nepal, *aya, i;* in Indo-China, *nya, a'io;* in Southern India, *aye, ava, avan, aval, ae, eka.*

The Javanese term assimilates more to Malay than to Malagaso-Polynesian, viz., *dewe*, yet it has analogies to all.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
We	izahai izakia	kami kita	o i matou maua, *or* taua *(dual)*	matau, tatau taua, maua *(dual)*	kakou kaua, maua *(dual?)*

HINDOSTAN.

Rodong, *kai;* Nachhereng *kai, ka;* Yakha, *kani, ka;* Kulungya, *koi, koni;* Thulungya, *goi;* Bahingya, *go-i;* Sangpang, *kayi;* Darhi, *hami;* Denwar, *hami;* Kuswar, *hami;* Kocch, *hami;* Angami Naga, *awe;* Khyeng v Shan, *kinni;* Chentsu, *hame;* Tamil (anc.), *yam;* Tamil (mod.), *nam;* Waling, *ika;* Siamese, *rau;* Ahom, *rau;* Khamti, *hau;* Laos, *hau.*

In the first line, the root of the Malagasi, Malay, and Samoan, is evidently *ai, oi;* and of the Maori and Hawaiian, *tau, kau.* In the second line, the root of Malagasi and Malay is *ia*, or *kia.* In the Samoan, Maori, and Hawaiian, the root is *ka, ma, ta,* with *ua* (two) added—*i.e.*, we two. The consonants are transposible in the respective different languages as I have shown in a previous paper.

In the Continental races, analogues of the Malagasi, Malay, and Samoan, are found in Nepal, *kai, ka, kani, goi, kayi, hami;* in N.E. Bengal *hami;* in E. Bengal, *awe;* in Burmah, *kinni;* in Central India, *hame;* and in South India, *yam nam.* Of the Malay—in E. Nepal, *ika;* of Maori and Hawaiian—in Indo-China, *rau, hau.*

The Javanese use the singular and plural equally, as *aku*, which is the Malay for I.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
You	hianareo	angkau, kau, kamu	outou oulua *(dual)*	koutou korua *(dual)*	oukou olua *(dual?)*

HINDOSTAN.

Kiranti, *khananin;* Rodong, *khanai;* Rungchenbung, *khananin;* Chhingtungya, *hananina;* Nachereng, *anai;* Waling, *hanani;* Kulungya, *anai;* Dungmali, *hananin;* Talain v Mon, *bintau;* Sgau Karon, *thu;* Ahom, *khau;* Gurung, *kenmo*.

The Malagasi analogy with Malaya and Polynesia is very distinct; but allowing for transference of consonants, the analogies between the latter are very close.

In the Continental races, analogues of the Malagasi are found in East Nepal, *khananin, khunai, hana nina, anai, hanani, hananin;* of the Malay and Polynesian dialects—in Indo-China, *bintau, thu, khau;* and of the Malay *kamu*—in Nepal, *kenmo*.

The Javanese term is *kowe* or *kaue*, which assimilates to the Polynesian dialects.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
They	izi *or* izareo	dei-orong	'oi latou 'oi laua *(dual)*	ratou, ratau raua *(dual)*	o lakou o laua *(dual?)*

HINDOSTAN.

Pahri, *usi, hosi*; Talain v Mon, *nyitau;* Siamese, *khau-arai;* Khamti, *mau-khau*.

In Malagasi, Malay, and Samoan, *ii, ia, ei, oi*, are the roots of the words; the consonants taking their place according to the structure of each language. In Malagasi and Malay, *areo* and *orong* are suffixes, probably with the same meaning, which, in Malay, is men—*dei-orong* (literally, they men). Samoan here appears, as it did in the first person plural, as the junction between the West and Eastern dialects of the great Barat language, by its using both expressions; *latou*, in meaning, being a reiteration of *'oi*,—that is, *they they*.

In the Continental races, the analogue of Malagasi, Malay, and Samoan *'oi* is found in Nepal, *usi, hosi;* and of the Samoan *latou*, Maori and Hawaiian—in Indo-China nyi*tau*, *khau*arai, mau*khau*.

In Javanese, the expression is *dewe*, assimilating to *deia*, the Malay third person singular.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
This	iti, itoi io	ini iko	lenei	tenei	keia, eia

HINDOSTAN.

Gyarung, *chidi;* Sopka, *ani, yeni;* Tibetan, *di;* Pakhya, *yehi;* Denwar, *i;* Vayu, *i;* Bhutani v Llopa, *di, didi;* Burman, *i, thi;* Khyeng v Shan, *ini;* Kami, *hi;* Laos, *ni;* Ho (Kol), *ni;* Kol (Singhbhum), *nea;* Santali, *nia;* Bhumij, *ni;* Mundala, *nia:* Naikude, *id;* Kolami, *idda;* Savara, *ani;* Malayalma, *ita;* and Pakhya, *yo;* Newar, *tho;* Munipari, *yo;* Khari Naga, *pio;* Ahom, *iu;* Tamil, *idu;* Karnataka, *idu;* Kurgi, *iru, idu.*

The words in the first line are radically the same, the root being *ii, ioi, ii, ei, eia,* the consonants being transposible according to the structure of each language. The words in the second line are merely a variation of the same root *io.*

In the Continental races the analogues of all the tribes are found in Tibet, *chidi, ani, yeni, di;* in Nepal, *yehi, i;* in North-east Bengal, *di, didi;* in Indo-China, *i, thi, hi, ni;* in Central India, *ni, nia, id, idda, ani;* in Southern India, *ita;* of Malagasi and Malay (second line)—in Nepal, *yo, tho;* in Indo-China *iu;* and in Southern India, *idu, iru.*

In Javanese the expression is *iki,* whose glossarial affinity is thus close.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
That	ini	itu	lela, lena	ia tena, tera, taua *(dual ?)*	kela

HINDOSTAN.

Sokpa, *theni;* Denwar, *i;* Kusunda, *issi, it;* Mithan Naga, *hiha;* Annam, *kia;* Ho (Kol), *en;* Kol (Singhbhum), *eno;* Mundala, *ana;* Savara, *ani;* Yorukala, *adu;* Tuluva, *avu;* Kurgi, *avu, adu;* Toda, *adu;* Kota, *adu;* Badaga, *adu;* Kurumba, *adu;* Irula, *adu;* Malabar, *ah thu, athu.*

The vocalic basis is *ii, iu, ea, ia, ea,* in all cases articulated by dento-palatals. In the Continental races the analogues of all the tribes are found in Tibet, *theni;* in Nepal, *i, issi, it;* in East Bengal, *hiha;* in Indo-China, *kia;* in Central India, *ana, ani, adu;* and in Southern India, *avu, adu, athu.*

It will be seen that Malagasi and Malay have transposed the terms thus: *itu,* that, in Malay; *itoi,* this, in Malagasi; *ini,* this, in Malay; *ini,* that, in Malagasi.

The Javanese expression is *ika,* which is radically the same as in other Barat races.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
Who	iza	siapa	o le oai	wai	wai, owai

HINDOSTAN.

Gyami, *sya;* Rodong, *sa;* Kami, *apa*-ime; and Kocch, *kai*; Mithan Naga, *oveh;* Tablung Naga, *owai;* Annam, *ai;* Laos, *khai, phai;* Ho(Kol), *okoi;* Mundala, *okowe;* Gadaba, *layi.*

The vocalic root of Malagasi and Malay appears to be *ia*, and of the Polynesian dialects, the reverse, *ai.*

In the Continental races, the analogues of Malagasi and Malay are found—in Tibet, *sya;* Nepal, *sa;* N.E. Bengal, *apa*-ime; and of the Polynesian dialects—in N.E. Bengal, *kai;* East Bengal, *oveh, owai;* Indo-China, *ai, khai, phai;* and of Central India, *okoi, okowe, layi.*

In Javanese, the expression is *sapa*, which is also sometimes used in Malay.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
What	inona	apa	o le a, se a	aha	he-aha

HINDOSTAN.

Manyak, *hano;* Karnataka, *yenu;* Tuluva, *jana;* Kurgi, *yennu;* Kurumba, *yenu;* and Chourasya, *ama;* Munipuri, *pa*-may-nay; Kami, *Apa*-i-me.

Malagasi appears in this instance to have, if any, very remote analogy with Malayan and Polynesian; the vocalic root of the latter is *aa, a, aa, aa,* the consonants appertaining to the respective tribes.

In the Continental tribes, the analogues of Malagasi are found in Tibet, *hano;* and in Southern India, *yenu, jana, yennu, yenu;* and of Malayan and Polynesian—in E. Nepal, *ama;* E. Bengal, *pa*-may-nay; and Indo-China, *apa*-ime.

In Javanese the term is *apa*, which is the Malay word.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
Little	keli	sadikit	iti-iti	iti	li-i, lii-lii

HINDOSTAN.

Gyarung, *kuh-che;* Kiranti, *chichi;* Rodong, *pichhe;* Rungchenbung, *chichi;* Nachhereng, *chichha;* Waling, *achichi, achi;* Kulungya, *chichha, gichha;* Thulungya, *kichwe;* Bahingya, *kachi;* Khaling, *tihiche;* Dungmali, *achichi;* Singpho, *katsi;* Garo, *kitek si;* Bodo, *tisi, kitisi;* Nowgong Naga, *ishika;* Shan, *aït;* Annam, *it;* Gadaba, khan*diki.*

The vocalic root in all cases is—*ei, ii.* The Malagasi *keli* approximates more nearly to the Malay *kichi* or *kichil*, which signifies small; yet, as

dentals and palatals are constantly transposible, the expressions are radically the same. The root of the Malay word *sadikit* is *iki*, the prefix *sa* meaning one. In Samoan and Maori, the palatal *k* is transposed to the dental *t*; while, in Hawaiian, consistent with the extreme weakness of that dialect, the consonant is eliminated.

In the Continental tribes, the analogues are found—in Tibet, *kuh-che*; in Nepal, *chichi*, *pichhe*, *chichi*, *achichi*, *achi*, *chichha*, *gichha*, *kichwe*, *kachi*, *tihiche*, *achichi*; in N.E. Bengal, *tisi*, *kitisi*, *kiteksi*; in East Bengal, *ishika*, *katsi*; in Indo-China, *aït*, *it*.

The Javanese term is *satitik*, which assimulates to Malay and Polynesian.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAAIAN.
To-day	anio	'ari-ini	ao-lenei	ai-anei	he-ao-eia

HINDOSTAN.

Brahui, *ainu*; Limbu, *ain*; Kiranti, *ai*; Rodong, *ai*, *ale*; Rungchenbung, *ayo*, *ai*; Waling, *ailo*, *ayo*; Lohorong, *ayu*; Dumi, *anyol*; Khaling, *anyalo*; Dungmali, *a-i*; Bodo, *dine*; Dhimal, *nani*; Mithan Naga, *anyi*; Khari Naga, *thani*; Singpho, *daini*; Burman, *yane*; Kami, *weini*; Kumi, *waini*; Tounghthu, *hanne*; Laos, *wanni*; Keikadi, *iuanu*.

In the Continental tribes the analogues are found in W. Hindostan, *ainu*, which assimilates to Malagasi; in Nepal, *ain*, *ai*, *ailo*, *ayo*, *ayu*, *anyol*, *anyalo*, *ai*; in N.E. Bengal, *dine*, *nani*; in E. Bengal, *anyi*, *thani*, *daini*; in Indo-China, *weini*, *waini*, *hanne*, *wanni*; in Central India, *iuanu*.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
When	rahoviana	bila	pe-a	ahea	ahea

HINDOSTAN.

Khaling, *hebelo*; Bodo, *mabela*; Garo, *biba*.

The vocalic root in all cases is *ia*, *ea*, but the Malagasi seems to be a compound word. In Malay and Samoan the consonants are both labials, which are eliminated in Maori and Hawaiian.

In the Continental tribes the analogues are found in Nepal, *hebelo*; N.E. Bengal, *mabela*, *biba*.

The expression in Javenese is *kapan*, which is sometimes used in Malay; the same is found in the Tharu tribe, Nepal, *kabahu*; in the Kocch tribe, N.E. Bengal, *kab*; and in the Tengsa Naga tribe, E. Bengal, *kapa*.

English.	Malagasi.	Malay.	Samoan.	Maori.	Hawaiian.
Ant	vitsikia	semut	loi	pokorua	he nonanona

Hindostan.

1. Mithan Naga, *tiksa ;* Namsang Naga, *tsip-chak ;* Sak, phun-*si-gya.*
2. Newar, *imo ;* Shan, *mot ;* Siamese, *mot ;* Khambi, *mot ;* Laos, *mot.*

In this word there is no similarity of expression in the several Barat tribes, which is curious.

In the Continental tribes, the analogues for Malagasi are found in E. Bengal, *tiksa*, *tsip-chak ;* and in Indo-China, phun-*si-gya ;* for Malay—in Nepal, *imo ;* and in Indo-China, *mot.*

In Javanese, the term is *semut*, which is the same as in Malay.

English.	Malagasi.	Malay.	Samoan.	Maori.	Hawaiian.
Man	olona	orong	tagata	tangata	he kanaka

Hindostan.

Ho(Kol), *horo ;* Kol (Singhbhum), *ho ;* Bhumij, *horro ;* Mundala, *horl ;* Kuri, *koro.*

There is no analogy between the Polynesian and western tribes of Barat in this word. Hawaiian is radically the same as Samoan and Maori,—the *k* being transposible into *t*, and *n* to *ng.* The vocalic root of Malagasi and Malay is *oo*, *r* and *l* being both dento-palatals, and *n* being transposible into *ng.*

In the Continental tribes, the analogues of Malagasi and Malay are found in Central India, *horo, ho, horl, koro.*

English.	Malagasi.	Malay.	Samoan.	Maori.	Hawaiian.
Mountain	tendrom, bohitra	bukit gunong	mauga	maunga	he mauna

Hindostan.

Newar, *gun ;* Burman, *taung :* Khyeng v Shan, *taung ;* Pwokaren, *kulaung ;* Taungh-thu, *koung.*

The *bohitra* of Malagasi, and *bukit* of the Malay, in their respective phonologies, are the same word. The Polynesian expressions stand alone.

In the Continental tribes, the analogue of *gunong* in the Malay language is found in Nepal, *gun;* of the Polynesian dialects—in Indo-China, *taung*, *kulaung*, *koung*.

The Javanese term is *gunong*, as in Malay.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
Oil	solikia	minia	u-u	hinu	aila

HINDOSTAN.

Madi, *ni*, *nai*, *niyu;* Keikadi, *yana;* Tamil, *neyam*.

In this case there is no analogy between the several Barat dialects. The Samoan *uu* is radically the Malay *susu*, *i.e.*, milk.

In the Continental tribes the analogues for Malay are found in Central India, *ni*, *nai*, *niyu*, *yana*, *neyam*.

In Javanese the term is *lenga*.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
Salt	fanasina	masin garam	masima	mataitai	he paakai

HINDOSTAN.

Sunwar, *yusi;* Angami Naga, *matse;* Tengsa Naga, *machi;* Savara, *basi;* and Rodong, *rum;* Nachhereng, *ram;* Waling, *yum;* Takha, *yum;* Kulungya, *gum;* Lohorong, *yum;* Lambichhong, *yum;* Balali, *yum;* Sangpang, *rum;* Dumi, *ram;* Khaling, *ram;* Dungmali, *yum;* Munipuri, *thum;* Mithan Naga, *hum;* Tablung Naga, *hum;* Namsang Naga, *sum;* Singpho, *jum;* Kuri, *bulum*.

All the Barat tribes have one vocalic root, viz., *ai* in Malagasi; Malay and Samoan, *asi;* and in Maori and Hawaiian, *ai;* these with prefix and suffix variations. The second term, *garam*, in Malay, is purely Continental.

In the Continental tribes, the analogues for all the dialects are found in Nepal, *yusi;* in E. Bengal, *matse*, *machi;* and in Central India, *basi*. For the Malay word, *garam*, we find in Nepal, *rum*, *ram*, *yum*, *gum;* in E. Bengal, *thum*, *hum*, *jum;* and in Central India, *bulum*.

The Javanese term is *uyah*, which has no prototype.

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
Skin	hoditra	kulit	pu-u iliola	hiako kiri	he alu alu hi ili

HINDOSTAN.

Rodong, *hulipa.*

Malagasi and Malay, under their respective phonologies, agree; but disagree with Polynesia.

In the Continental tribes, the only analogue is found in Nepal, and that is doubtful.

In Javanese, the term is the same as in Malay, *viz.*, *kulit.*

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
Crooked	—	bengko	fa-'api-'o	kopikopiko	e-pio

HINDOSTAN.

Sunwar, *bango ;* Pakhya, *banggo ;* Newar, *beko ;* Rodong, *banggo ;* Nachhereng, *banggo ;* Waling, *banggo ;* Denwar, *banko ;* Kuswar, *bango ;* Uraon, *bengko ;* Chentsu, *banko.*

There is no analogy between Malay and Polynesian.

In the Continental tribes, for the Malay, analogues are found in Nepal, *bango, banggo, beko, banko* ; in Central India, *bengko, banko.*

The Javanese assimilates to Malay, viz.. *bengkong.*

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
Fat	matavi	gammo limma	ga 'o mea lololo	ngako matu	momona puipui

HINDOSTAN.

1st.—Kocch, *mota ;* Uraon, *mota ;* Mundala, *mota ;* 2nd.—Serpa, *gyamo ;* Bhutani v Llopa, *gyamo ;* 3rd.—Toungh-thu, *pay;* Shan, *payi ;* Ahom, *pi;* Khamti, *pi;* Laos, *pi, tui.*

There is no analogy between Malagasi and Malay; strong analogy between Malay, Samoan, and Maori; but none with Hawaiian.

In the Continental tribes, the analogues for Malagasi are found in N.E. Bengal, *mota ;* and in Central India, *mota ;* for Malay, Samoan, and Maori —in Nepal, *gyamo;* and in Bhutan, *gyamo;* again for Hawaiian—in Indo-China, *pay, payi, pi,* and *tui.*

In Javanese, the term is *lemu,* which assimilates to the Malay second term, *limma.*

ENGLISH.	MALAGASI.	MALAY.	SAMOAN.	MAORI.	HAWAIIAN.
Eat	mihinana	makan	'ai	kai	e ai

HINDOSTAN.

Gyami, *khye;* Lohorong, *chae;* Dungmali, *choye;* Denwar, *khaik;* Kuswar, *khaik;* Tharu, *khai;* Shan, *kyen;* Siamese, *kenn.*

The root of all is *a*. In Malagasi, with a prefix of *mihin* and suffix of *na;* in Malay, of *mak* and *n*. In the Polynesian dialects the root is inflected.

In the Continental tribes, the analogues are found in Tibet, *khye;* in Nepal, *chae, choye, khaik, khai;* and in Indo-China, *kyen, kenn*, which latter assimilates to Malay.

In Javanese, the term is *mangan*, which assimilates to Malay.

As this will conclude the series of papers that I have written on the subject, commencing with an enquiry as to "The Whence of the Maori," but which has led me over extensive ground,* I shall now recapitulate some of the main points touched on.

This, or kindred studies, have arrested the attention of many previous writers on the mythology, traditions, chaunts, and legends of the Maori. I have read with interest the works and papers of Sir George Grey, Lieutenant Shortland, Mr. Colenso, and Dr. Arthur S. Thomson; but those authors who had dealt with the question to which my efforts have been more closely allied were especially Mr. James Richardson Logan and Mr. John Crawfurd, both of Singapore. The works of Humboldt, Bopp, and Hale, I have not been able to obtain. These enquirers had their attention engaged with kindred ethnological and philological fields, and in regard to that to which I have confined myself their notices have been incidental rather than comprehensive.

With such able ethnologists preceding me, it must be confessed that many facts were anticipated; yet my labours, I submit, need not be considered to be entirely thrown away, for—with the light that has been shed on the subject by the untiring labours of Hodgson, Hunter, Campbell, Koelle, Bleeck, Clark, etc., etc., whose dictionaries and vocabularies have only been recently published—I have had data brought to hand which the writers of thirty years ago could not obtain. These I have freely searched, using, as my clue, the Malayan tongue, with whose language and literature, as I have already stated, I can claim acquaintance.

In my first paper, which was ethnological, I was carried, in my search for the "Whence of the Maori," beyond Malaya (the popularly-accepted

* "Whence of the Maori" (Ethnological), Trans., N.Z. Inst., Vol. IV., p. 1.
Do. do. (Barata Numerals) do. Vol. V., p. 131.
Do. do. (Philological) do. Vol. VI., *App.*
"Barat or Barata Fossil Words" do. Vol. XI., p. 157.

fountain of the Polynesian race), the evidence leading to the following conclusions :—1st. That Hindostan, as well as the Indian Archipelago, at one time contained a negro population. 2nd. That waves of migration issued from the South Peninsula, or Barata, east and west. 3rd. That no western emigration ever proceeded out of Tamasak, or the south part of the peninsula of Malacca or Sumatra, so as to affect Madagascar. 4th. That the progress of the Barata is traceable eastward by language to the Moluccas, of which Ternati is the principal settlement. 5th. That the race was modified in colour and physiognomy by the incursions of the Mangians and Annamese, but not in language. 6th. With the Moluccas as a basis, a stream of the mixed race flowed eastward from island to island over Polynesia, one branch finding its way to New Zealand *viâ* Tongataboo. 7th. That Barata, or South India, was therefore the whence of the Maori.

My second paper was on Barata numerals, in which, of many tribes, I compared the numerals up to ten, scattered between Madagascar and Easter Island. The interesting fact which this enquiry divulged was to this effect: that within the regions occupied by the Barata race—of which the Maori is a portion—the more remote or primitive the tribes the greater was the analogy of dialect. Thus a remote tribe, the Lampong, occupying a portion of the interior of Sumatra, have their ten numerals identical with Maori; Madagascar has nine identical; so also have Tagala, Papango, and Mindanao, in the Philippines, and so forth; while the more accessible Malay has only five identical, Acheen only six, etc.

Of this subject I then remarked, that I hoped I had satisfactorily shown that the first ten numerals (in as far as their evidence was valuable) tend to prove the intimate connection that subsisted between an archaic race that spread over nearly two-thirds of the circumference of the globe, and in which expansion the Malay had no connection,* but the ethnological phenomenon was due solely to the illustrious Barata.

My next paper was philological, in which I scrutinized the structure of the languages of several of the leading races, glossarially, idiomatically, and phonetically—comparing first, Maori with Tongan; second, Maori with the many dialects of the Indian Archipelago; third, Malagasi with Malay; fourth, Maori with Malay; and lastly, the Murihiku dialect, New Zealand, with races in the Indian Archipelago.

The general conclusion arrived at from the evidence brought out was, that had Madagascar not existed, or had it not been populated by its present race, our search for the whence of the Maori as we proceeded westward, might have stopped at the Silong tribe of Mergui, on the eastern shores of the Bay of Bengal; but the above circumstances we have set forth, force us

* Excepting as a tribe or offshoot.

to proceed across the bay and point out, as I did in my former paper, that peninsula—fecund of people—viz., South Hindostan, alone commanding all possible eastern or western migrations, as the only possible whence of the Maori.

Here then ended my enquiries for the time, the conclusion was one decided by physical geography, supplemented only by ethnological and philological data; but I often asked myself: What of Hindostan itself? What of the Land of Barat, as the Malays term it? Are there no remnants of that archaic language in it, so as to corroborate this fine theory of the "whence of the Maori" being there? It occurred to me, that if I could bring the evidence of languages contained in fossil words, this would be satisfactory, in fact it would make my theory incontrovertible.

I had no opportunity to effect this desirable end till I went home lately on leave of absence, during which time, while in London, I gathered the material from various sources as stated in my last paper. From this material, which is found in the several vocabularies of the various primitive tribes that yet inhabit Hindostan, there were abundant proofs of intimate connection with the languages of Malaya, Polynesia, Madagascar, and even eastern Africa, in other words, with the wide-spread Barata race. It was then remarked by me that Hindostan is now overrun by two distinct sections of the human race, viz., Indo-Germanic, or Aryan and Turanian, or, in other words, the one Caucasian, the other Turanian; the one occupying the western and northern regions, the other the southern and eastern. And, in overrunning Hindostan, have they extirpated the primitive races? Not entirely; many of these remain, much modified, it is true, in colour and physiognomy, but little in language. The *roots of a language die only with a tribe's extirpation.* Hence it is not in the languages of the intruding sections that we have found the Barata fossil words, but for the most part in the various small tribes yet preserved in the obscure portions of their territory, difficult of access, such as under the Himalaya, Jynteah, and Nilgherry mountains. In these, the undeleted glossarial remains of what had been the language of a numerous people once inhabiting the fertile plains, we have witnesses to facts and conditions of nations long since past, and preceding historic record.

As to this, my last paper, I may state that so far as it goes it substantiates the conclusions of those preceding; there being 261 analogies in Hindostan of the 22 words selected from five Malagas-Malayo-Polynesian dialects. Further, in comparing these, as I have done, with the Aryan, Mongolian, or Semitic, or other Asiatic races—ancient or modern—no analogy can be detected.

In this paper, giving 22, and my last, 43, making 65 primary words (a large portion in an aboriginal language), of which there were 261 and 235

analogies, respectively, in the tribal tongues of Hindostan,—total, 496—all the proofs that glossarial connection can give, are adduced. The expressions denoting this glossarial connection I have termed "word-fossils," for they indicate a race with as unerring an indication as the *Graptolite*, the *Holyptichius*, or the *Stigmaria*, point out those separate geological systems displayed in the Silurian, the Old Red Sandstone, and the Carboniferous, respectively, wherever spread on the face of the globe.

In these papers I have given more attention to the glossarial branch than to the ideological or phonetic, simply because I have found it to be the most unchanging, and, therefore, the best indicator of race affinity.

The Malay and Polynesian languages are compounding in their construction; the Malagasi is inflecting; yet, this peculiarity connects it with the Dravidic,—*i.e.*, dialects of South Hindostan.

All have re-duplication in the construction of many words; and that most attenuated of the dialects, *viz.*, Hawaiian, has triplication, and even quadruplication—such as, *lelele*, to leap; *lelelele*, to run off. The Polynesian *dialects* have dualism in their pronouns; a fact which I have not discovered in Malagasi or Malay.

The roots of the most simple primary words are vowels, the consonants being merely additions or acceptations, according to the genius of each dialect. That the consonants are transposible, as between tribe and tribe, we have seen many indications; and that they are even ever-changing in single tribes, we have the evidence of the Rev. S. J. Whitmee. He says,* the consonant *k* is found only in one word in Samoa (to wit,—in *puke*), adding, that to a person now for the first time visiting Samoa this would appear to be incorrect. He would hear *k* used by most of the natives in their ordinary conversation in place of *t*; but this is a recent change. In 1863, *k* was used only in the island Tutuila and in the eastern portion of Upolu; now, it is used all over the group. It is difficult to say how this change was commenced, but its spread has been noted, and every attempt has been made to arrest it, but without effect. Many of the natives are exceedingly careless and incorrect in the pronunciation of consonants, and even exchange or transpose them without confusion and almost unnoticed by their hearers,—as, *manu* for *namu*, a scent; *lagogu* for *lagonu*, to understand, etc.

Besides scrutinizing beyond Hindostan the dictionaries of the various races of Asia, Europe, and Africa, I have also carefully gone over numerous vocabularies of the aboriginal tribes in North and South America, and here also I have failed to detect the semblance of glossarial analogy. All philological evidence then turns to Hindostan, the Land of Barat, as the original

* Samoan Grammar,

seat of the Maori race. And here I may express a thought which has occurred to me, in conclusion,—that the native chiefs of New Zealand, while, by the treaty of Waitangi, they ceded and yielded up the sovereignty of their territories to the Queen of Great Britain and Ireland only forty-four years ago, now also, in her capacity as Empress of India, is she the Sovereign of their race by archaic connection from time immemorial, far preceding the age of history or of letters.

ART. XX.—*Moriori Connection.*

By J. TURNBULL THOMSON, F.R.G.S., F.R.S.S.A., etc.

[*Read before the Wellington Philosophical Society, 23rd August,* 1879.]

THE basis of this paper rests on a Moriori vocabulary, prepared by S. Deighton, Esq., R.M., Chatham Islands, furnished to the Native Department, Wellington, at the instance of Government, and it forms a proper sequel to the several papers I have written on the "Whence of the Maori," etc.

For distant readers it is necessary that I should explain that the Moriori tribe is by tradition said to have occupied the New Zealand islands before the coming of the Maori. A small remnant now only exists in the isolated and remote Chatham Islands, situated some 200 miles to the east of the main group; and to record what yet exists of their language has for some years been the desire of the authorities of the department in charge of native affairs. By the courtesy of Mr. T. W. Lewis, secretary to the Native Department, I have been entrusted with the analysis of a copy of the above-mentioned vocabulary with the view of ascertaining its philological connection with kindred races.

The vocabulary consists of 168 words, principally radical or primary. But, for the purposes of a comparative vocabulary*, the words are reduced to 155 in number, and of these 115 are pure Maori; hence the Moriori can only be said to be a dialect of this Polynesian race which now inhabits New Zealand—it is distinctly not a separate language. Under these circumstances, it would be tedious and out of place to transcribe the whole of Mr. Deighton's valuable vocabulary. I have therefore confined myself to making a comparison of those Moriori words which are not pure Maori, showing where they are to be found amongst other Malagas-Malayo-Polynesian, or Barat races.

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* Some of the words are phrases, and for some I have not been able to find the Maori equivalent.

Of course it must be understood, that the investigation is circumscribed by the limited number of dictionaries or vocabularies in my possession; thus, though many of the words are not found in them, yet it is not to be taken for granted that they will not be *dug out* from the *strata* of the many yet unknown languages spoken between Madagascar and Polynesia; all experience showing that radical words are never wholly lost, for if one branch of a race accepts new words, another branch yet retains them.

Coming to remarks on the comparison, it will be seen that there are thirty-nine out of the one hundred and fifty-five words which are not Maori, or else, if Maori, are variations of the language sufficient to claim distinctive notice. Of the first word, *i.e.*, the personal pronoun I, the Moriori analogue is found in three of the principle groups in Polynesia, and also in fourteen of the tribes of Non-Aryan Hindostan. But the analysis of this portion of the subject will be best made, by such readers as are interested, for themselves. I shall therefore confine myself to generally stating, that there are fifteen Moriori words out of the thirty-nine which are not reproduced in the limited list of works which I possess.

Five words will be seen to belong to the Fijian Group, four to the Samoan, twelve to the Hawaiian, two to the Murihiku dialect of New Zealand, eleven to the Malay, two the Malagasi, seven to the Non-Aryan tribes of Hindostan, but, stating it differently, these seven words are found seventy-seven times in these Barat tribes.

The inferences to be drawn, so far as inferences can be made from such limited data, are consistent with the principle elucidated in the previous papers, viz.: that the furthest and earliest waves of migration accord most in the roots of their languages with the centre from which they migrated. Thus as we know the Moriori to have preceded the Maori, we accept him to be one of these earliest waves. The analogy between it and the Hawaiian (an acknowledged most primitive tribe) is, therefore, striking; but the more so is this the case when we scan the root-words of the archaic focus of the race in Ancient or Non-Aryan India.

The deductions therefore accord with those of preceding papers.

ENGLISH.	MAORI.	MORIORI.	OTHER LANGUAGES.
I ..	au ; ahau	ko au	*koi au*, Fijian; *o-au*, Samoan; *owau*, Hawaiian. And non-Aryan Hindostan—*go*, Sunwar; *go*, Thulungya; *go*, Bahingya; *ku*, Laos; *go*, Vaya; *go*, Lepcha, Sikkim; *ka*, Dhimal; *ku*, Mithan Naga; *ngo*, Abor Miri, and Sibsagar Miri; *kau*, Ahom, and Khamti.
Who ..	wai	ko wai	*o-cei*, Fijian; *o-ai*, Samoan; *owai*, Hawaiian. And non-Aryan Hindostan—*ka*, Bhutani and Lhopa; *kai*, Kocch; *owai*, Tablung Naga; *khai*, Laos; *okoi*, Ho(Kol); *okoe*, Santali; *okowe*, Mundala.
To-day ..	aianei	a ta ranei	*hari ini*, Malay; *anio hiani*, Malagasi. And non-Aryan Hindostan—*ai*, Kiranti, Rodong, Rungchenbung, and Dungmali; *nani*, Dhimal; *anyi*, Mithan Naga; *daini*, Singpho; *yane*, Burman; *wei ni*, Kami; *wai ni*, Kumi; *hanne*, Toungh-thu; *wanni*, Laos.
Bone ..	iwi	imi	
Eye	kanohi	konehi	Non-Aryan Hindostan—*khan*, Brahui; *kan*, Thochu; *khan*, Uraon; *kane*, Rajmahali; *kan*, Gondi; *kanak*, Rutluk; *kannuka*, Khond; *kan*, Tamil; *kanna*, Malayalma; *kannu*, Telugu; *kannu*, Karnataka; *kann*, Tuluva, Kurgi, and Toda; *konn*, Toduva; *kannu*, Kota, Badaga, Kurumba, and Irula; *kan*, Malabar.
Head ..	upoko	uraki	Non-Aryan Hindostan—*mura*, Kocch.
House ..	whare	wheau	
Mosquito ..	waeroa	koringa	Non-Aryan Hindostan—*ninga*, Kolami; *ningal*, Naikude; *kirigi*, Gadaba.
Mountain ..	maunga	makutere	
Slave ..	herehere	mokai ; tutua	
Stone ..	kohatu	pohatu	*pokahu*, Hawaiian; *batu*, Malay; *vato*, Malagasi. Non-Aryan Hindostan—*hathou*, Gyami.
Bad ..	kino	etae wahike	*tei* (filth), Malay.
Red ..	kura	ura	he ula *ula*, Hawaiian. Non-Aryan Hindostan—*ulan*, Sokpa; *hola*, Kiranti; *harra*, Lohorong; *arra*, Ho(Kol); *arah*, Santali; *erra*, Telugu.
Island ..	motu	whatu	
Butterfly ..	pepepe	purehurehu	he *pule lehua*, Hawaiian.
Face ..	mata	iahu	

English.	Maori.	Moriori.	Other Languages.
Feather ..	hou; raukura	uru manu	*huruhuru*, Murihiku, New Zealand; he *hulu* o ka *manu*, Hawaiian; *hulu*, Malay; *vol*omborona, Malagasi.
Thumb ..	koromatua	to nui	ka lima *nui*, Hawaiian.
Root ..	akaaka	paki aka	*puhaka*, Murihiku, New Zealand; *pogai a'a*, Samoan; *ke aa*, Hawaiian; *akar*, Malay.
Dung ..	wai-rakau	tutae	*de*, Fijian; *tae*, Samoan; *tei*, Malay.
Grass ..	otaota	rau	daun (leaves), Malay.
Know ..	matau	*ki*tee	*ki*la, Fijian; *e ike*, Hawaiian; *ki*nal, Malay.
Life ..	oranga	ti oranga	*olaga*, Samoan; *ke ola ana*, Hawaiian; *orang idup*, Malay.
Heart ..	ngakau	manawe neti	*ati*, Malay.
Passing ..	wani, etc.	ti ahenga	
Rotten ..	pirau	pere	
Sing ..	waiata	kara mia	
Truth ..	pono	tika	
Worm ..	toke	tunga	
Waves ..	piupiu	rehu moana	
North ..	nota?	whakuru	he ku*kulu* akau, Hawaiian.
South ..	tonga	uru	he ku*kulu* hema, Hawaiian.
East ..	rawhiti	maranga	
West ..	hauauru	raki	*ra*, Fijian.
Hill ..	puke	takupu	he mauna uu*ku*, Hawaiian.
Naked ..	kau	ko re kirianake	
Thatch ..	tapatu	tua rau	*lau*, Samoan; daun tua (old leaves), Malay.
Abundant ..	nui	ku ai	
Arm ..	ringaringa	ririma	*lima*, Hawaiian.

II.—ZOOLOGY.

Art. XXI.—*Notes on* Ziphius (Epiodon) novæ-zealandiæ, *von Haast—Goose-beaked Whale.* By Prof. Julius von Haast, Ph.D., F.R.S., Director of the Canterbury Museum.

Plate VIII.

[*Read before the Philosophical Institute of Canterbury*, 26*th November*, 1879.]

In a former volume of the Transactions of the New Zealand Institute,* I offered a description of the skeleton of this interesting Southern Ziphioid Whale. I then stated on the authority of the late Mr. F. Fuller, taxidermist of the Canterbury Museum, who went to secure the skeleton of that specimen, stranded in Lyttelton Harbour, some details about the characteristic form and colour of the skin of the animal in question. When my informant arrived where the fishermen were at work, he found that the blubber had nearly all been taken off, so that he could only partially obtain the required measurements. From the observations I am about to offer to the Society, on two more specimens stranded since then on our sea-beach, it will be seen that some of the statements were far from being correct.

In fact, the animal was so much cut about that its lower part was taken for the upper, and *vice versâ*, and consequently no dorsal fin could be found where it was looked for. The first of the specimens under review was stranded on Sunday, the 17th of November, 1878, near New Brighton. There were numerous visitors at the time who observed another whale (according to other lookers-on, two whales) in the offing, by which the animal was driven into the surf, where soon it became helpless. Gradually it was drifted upon the low sandy beach, where it died only after a long struggle. Having received prompt information, I arrived early next morning on the scene, and found the animal quite intact, so that I could not only take the necessary measurements, but also have a careful sketch prepared, which, as the sequel will show, is of importance, in offering us some curious information as to the habits of this species of Ziphioids.

Colour: Head, neck, and anterior portion of the back, as far as the dorsal fin, white; the rest of the body black; a white narrow line running along the edge of the dorsal fin, which is otherwise black. The line of division between the two colours is everywhere well marked, except upon

* Trans. N. Z. Inst., Vol. IX., p. 430.

the cheeks, where blackish blotches advance some distance towards the nose. The cylindrical form of the animal for its length is rather slender, its height at the occiput being only 2 feet 3 inches, and at about nine feet from the tip of the lower jaw 3 feet 3 inches, after which it tapers gradually to the tail. The animal proved to be a young female.

The two teeth at the termination of the lower jaw stood half an inch above the gums, having a diameter of one inch where they rose above the latter. They are conical, and have a sharp apex, and are not covered anywhere with enamel, not even on the tip. The dentine shows a number of horizontal lines one above the other, running round the tooth. They are therefore quite different from the teeth of the two specimens described in Vol. IX. (Transactions of the New Zealand Institute), which were found to be covered with a rough cement. They are also different from those of another specimen, of which I shall give some details further on.

A single fold begins below the throat, 1 foot 1 inch from the top of the lower jaw. After rising rapidly for four inches, it continues for seven inches more at a smaller angle, ceasing where the black colour of the throat begins. This fold is separated into two portions by a ridge of the breadth of half an inch below the centre of the throat.

Lips flesh-coloured; roof of mouth slaty-black; no signs of teeth along the jaws; there is, however, a hardened ridge along both sides of the palate. The extremity of the lower jaw projects about two inches beyond the upper. The head rises steeply above the upper lip to the forehead.

The blow-hole is situated on the vertex of the head just above the eye. Both the form and the size of the dorsal fin and of the tail-lobes, show that this species must be a remarkably swift swimmer.

Measurements.

	FT.	IN.
Total length	19	6
Greatest circumference	9	9
From point of lower jaw to the beginning of the pectoral fin	4	9
From fork of tail to termination of falcate dorsal fin ..	6	5
Length of the opening of the mouth	1	3
From point of lower jaw to eye	2	6
From point of lower jaw to beginning of fold below throat	1	1
Diameter of blow-hole concave towards head	0	6
From fork of tail to vent	5	4
From fork of tail to pudendum	6	6
Breadth of caudal fin	6	1
Base of dorsal fin	1	1
Height of dorsal fin	0	8
Breadth of pectoral fin	0	7
Length of pectoral fin	2	6
Eye, horizontal diameter	0	1½
Eye, vertical diameter	0	1

Before giving a description of the external appearance of the specimen under review, I wish to allude to another female, 21 feet 6 inches long, of the same species, stranded on May 15th, 1879, on the sea-beach near Kaiapoi, and of which the skeleton was also secured.

This was, doubtless, a full-grown, aged animal, the terminal epiphyses being so well anchylosed to the body of the vertebræ that even the line of junction could be scarcely distinguished, while in the New Brighton specimen these discs were still unanchylosed, and detached themselves readily during maceration.

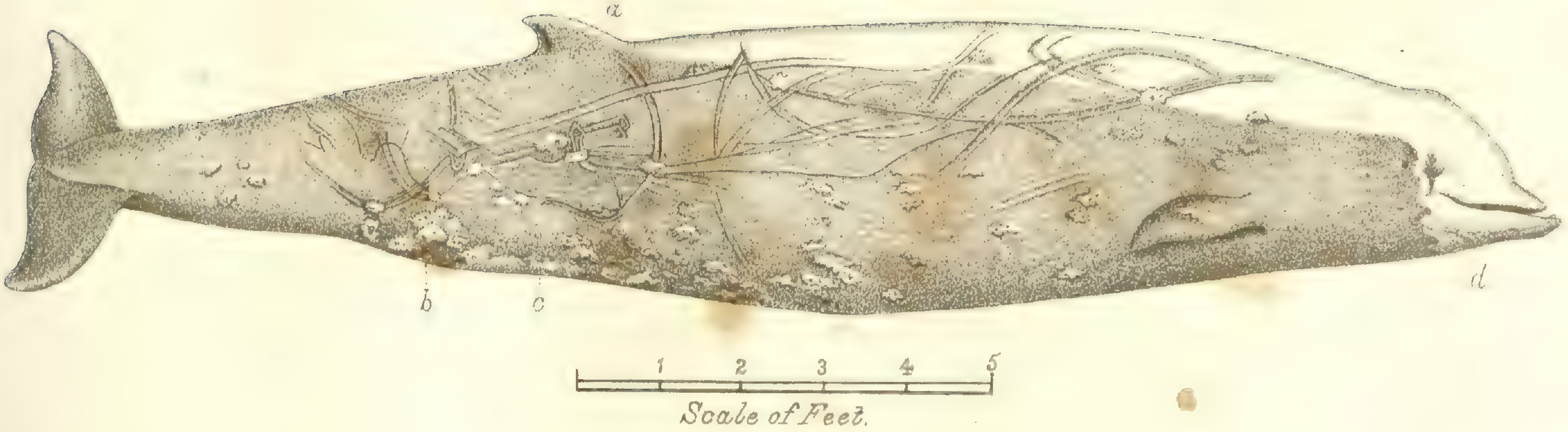
In form of the body, and colouration, this animal resembled in every respect the New Brighton specimen. However, the two teeth existing at the tip of the lower jaw could not be felt when passing the fingers over the gums, and were only disclosed when making incisions.

The teeth are the smallest of all those known to me, being 1·98 and 2 inches long, and only ·46 of an inch broad. The left tooth weighs 66 and the right 62 grains. The flattened root is square, and somewhat constricted a quarter of an inch above the base, after which the tooth expands, being broadest about the middle. It then contracts rapidly, running out to a sharp point. This is thus confirmatory evidence that the teeth, with age, are absorbed, and disappear gradually below the gums; although it is possible that even below the gums they may still be of some use to the animal. It is a peculiar character of the small teeth of the Kaiapoi specimen that they should be so very thin, and terminate in a sharp point; and that the latter should be covered with real enamel, different from any oberved upon the dentine in any other teeth of the same species.

Returning to the first-mentioned specimen from the New Brighton beach, of which the annexed sketch (*Pl. VIII.*) gives a faithful representation, it must strike us with astonishment to see the skin of this animal, a female, so fearfully lacerated. The late taxidermist of the Museum, when giving me some notes of the external appearance of what remained of the specimen stranded in Lyttelton Harbour in July, 1872, informed me that the upper portion was marked by numerous oval spots, 2–3 inches across, like the skin of the leopard; this, as I observed already, was the lower portion. Moreover, he thought that the animal must have had fearful struggles amongst the rocks, the skin appearing torn in all directions. These peculiar oval spots were visible at the first glance on the skin of the New Brighton specimen; but when examining them more closely it at once became clear that they were not natural, but were the scars of injuries the animal had received during life-time at various periods.

At the same time, the animal being also covered with a number of seamed scars, running in all directions, their form and regularity proved

also that they could not have been caused by the animal being thrown amongst the rocks; but must have been inflicted by some other animal. Examining the oval spots, I found that, although they varied from a length of 2 inches, to that of 3 inches, and from a breadth of 1 inch, to that of 2 inches, they had invariably the same character, viz.: that of an oval scar of a dirty whitish colour, both in the white and the black colouration of the skin, with two well-marked points in the centre, always about $1\frac{1}{4}$–$1\frac{1}{2}$ inches apart. These two dots had evidently been the wounds inflicted, round which the scar had been formed. In some instances these points were quite healed over, so as to show that the injury had been done long ago; in others there were two fresh sores, as if the animal had been struck only a few hours before its death. Although occurring all over the body, with the exception of the back, these oval scars were most frequent below the belly, and principally round the pudendum, where they were often so close together that the scars not only ran into each other, but evidently covered each other, so as to show that the same spot had been struck repeatedly. The seamed scars, on the other hand, occurred more on both sides of the animal. Only a few crossed the back or reached to the belly. With a few exceptions these seamed scars were always in pairs, $1\frac{1}{4}$–$1\frac{1}{2}$ inches apart, and each about $\frac{1}{4}$ inch broad. Some of them were running for a considerable distance, 7–8 feet, others only for a space of a few inches. That there had been considerable struggle became evident from the direction these seamed scars had taken, some forming, as at *a*, regular hooks. Some of these wounds were evidently of long standing, being well healed, others had only been inflicted a very short time before the stranding of the animal, as they were quite fresh and deep, and sometimes have a breadth of $\frac{3}{4}$ of an inch. From the character of these wounds, it appears certain that they could have only been made by an animal or animals of the same species with the two teeth of the lower jaw, the distance of their apices being $1\frac{1}{4}$–$1\frac{1}{2}$ inches from each other, and thus corresponding with both the oval and seamed scars. The aged female from the Kaiapoi beach, of which I gave some particulars on the preceding pages, was scarred and seamed in exactly the same manner. It is thus evident that the females are subject to attacks either from the males during rutting time, or that they fight amongst themselves. In the latter case, which, however, appears to me to be rather improbable, the teeth of the figured specimen must have been of considerable use to the animal, and it is then difficult to understand how the full-grown or aged animals, when their teeth disappear below the gums, can successfully resist the attacks of the younger members of the same species, unless their greater bulk, or probably greater speed, make up for this disadvantage. Of the males of *Ziphius novæ-zealandiæ* we know nothing at present, but there



ZIPHIUS (*EPIODON.*) NOVÆ ZEALANDIÆ, *Von Haast.*

Von Haast, del.

J.B. lith.

is no doubt in my mind that with them the teeth in front of the lower jaw are both permanent and of larger size than those of the females, just in the same manner as they exist in other *Ziphioid* genera. Fortunately, however, there is some evidence at hand strengthening such an hypothesis.

Dr. Hector, in his account of the skull of *Epiodon chathamiensis*,* obtained in the Chatham Islands, describes the teeth of this species, as follows:—"The lower jaw * * * terminates in two, short, stout, slightly compressed teeth, 2 inches long, and 4 inches in circumference, implanted in shallow sockets. The teeth have slight, irregular striæ, and are worn down into two lateral facets, divided by an acute ridge. The position of the teeth, when the jaws are closed, is 2 inches beyond the upper mandible, and unless they are applied against callosities on the upper lip, it is difficult to conceive how they are worn down to this acute form. Weight of teeth 817 and 836 grains."

"Two teeth, of similar form, taken from the jaw of a whale cast up on the Manawatu beach, have their facets forming an obtuse pyramidical tip.' Of this last pair of teeth no weight is given, but it is evident, from the drawing, that they must be as heavy as the former. The teeth of the females, examined by me, range from 62 to 200 grains. There is no doubt that the form and chief characteristic features of the skull from the Chatham Islands, described as *Epiodon chathamiensis*, and those of the two female whales secured by me, are almost identical, if we except the teeth, which in the former are at least four times as heavy as in the latter. In my paper on *Ziphius novæ-zealandiæ*, in Vol. IX., of the Transactions of the New Zealand Institute, I pointed out already that the skull of this Chatham Island whale might have belonged to the male of *Epiodon novæ-zealandiæ*, thus accounting for the difference. After having seen the two female animals stranded on our beach, scarred in such a remarkable manner, I am more than ever inclined to this opinion. If the three specimens alluded to had been males, it would be easy enough to understand that the wounds had been inflicted during their fights in rutting time, or for supremacy, as this is the case with most of the terrestrial animals. However, the fact that the wounds inflicted in striking against the animal, by which the oval scars were produced, are mostly in close proximity to the pudendum, suggests forcibly that they have been inflicted by male animals. In respect to the external appearance of the different species of other *Ziphioid* genera, such as *Mesoplodon*, *Berardius*, and *Oulodon*, of which several specimens, both male and female, have been examined by me, I may state that none of them had the least scar or wound upon them.

Of course, this may be accounted for by the fact, that the teeth of most of these genera are situated so far backwards that they could scarcely be nsed

* Trans. N.Z. Inst., Vol. V., p. 165.

for the same mode of attack. Dr. Hector* has given an account of the capture of an adult male of *Berardius arnuxii* in the entrance of Wellington Harbour, on January 12th, 1877, from which it appears that "the teeth did not penetrate the gums, nor could their position be discovered till deep incisions were made." This leads me to conclude that the male of this species cannot use the teeth in the same manner as *Ziphius novæ-zealandiæ* does. Thus this species of Ziphioid Whale, as far as our observations in New Zealand go, stands apart in this strange habit of life by which, as far as we know at present, both young and aged females are made sufferers, the form and peculiar position of the teeth in front of the protruding lower jaw, making these savage attacks possible. It will be of some interest to obtain a male of the same species, in order to ascertain if it is also covered with similar scars. The outlines of the right side of the animal were drawn from careful measurements, and the oval and seamed scars conscientiously copied from nature by Mr. T. S. Cousins.

Finally, I should like to make a few observations on the nomenclature, and the changes proposed.

There is no doubt that the generic name *Epiodon* has to give way to *Ziphius*, but I think it rather premature to follow Dr. Hector's example, and to merge our New Zealand species into the European *Ziphius cavirostris* of Cuvier, till we possess some more detailed accounts of the form, colour, and anatomical structure of the different species of *Ziphius* described under various names from other countries. For instance, we know already that the *Epiodon australe*, of Burmeister, had a light ash-colour (*ceniza clara*), that it was darker on the back, lighter on the belly, and moreover, that its forehead was not swollen. *Epiodon desmarestii*, according to Risso, is steel grey, with numerous irregular white streaks, beneath white, head not swollen, ending in a long nose. Consequently, in both these well-described species, there is considerable difference in their appearance when compared with the New Zealand *Ziphius*, a difference which certainly is of some specific value, and ought not to be set aside without good cause being shown to the contrary.

In plate VIII., *b* is the vent, *c* the pudendum, and *d* the fold.

Art. XXII.—*On the Occurrence of the Red-capped Dotterel* (Hiaticula ruficapilla) *in New Zealand.* By T. W. Kirk, Assistant in the Colonial Museum.

[*Read before the Wellington Philosophical Society, 11th October,* 1879.]

I have much pleasure in laying before the Society a fine specimen of the Red-capped Dotterel, which was obtained in December last on the beach

* Trans. N.Z. Inst., Vol. X., p. 338.

between Otaki and Waikanae. At first sight I took it to be a very small specimen of the Banded Dotterel (*Charadrius bicinctus*), several specimens of which were lying near, but observing that the colouration of the feet, breast, and head differed very much from that of *C. bicinctus*, I carefully preserved the skin.

Having since made a minute examination, I have not the slightest hesitation in pronouncing it to be a specimen of Gould's *Hiaticula ruficapilla;* it appears to be a very common Australian species.

Mr. Gould, in his "Handbook to the Birds of Australia,"* states:—"The Red-capped Dotterel is universally dispersed over every part of the sea-shores of Australia that I have visited, and everywhere evinces a greater preference for the shingly beach of the ocean, and especially for deep salt-water bays, than for the sides of rivers and inland waters; it is very numerous in Tasmania, on Flinders' Island, on the sand-banks at the mouth of the Hunter in New South Wales, and at Port Adelaide in South Australia; and Gilbert states that it is equally abundant in Western Australia, where it is likewise so strictly a bird of the coast that he never saw it inland. It is usually met with in pairs, but may be occasionally observed associating in small companies:—

"Like the *Tringæ*, this bird resorts to every possible device in order to lure the intruder from its nest; throwing itself down upon its breast and flapping its wings, as if in the agonies of death, it will so continue until he has approached almost near enough to place his hand upon it, when it moves along for several yards, dragging one of its legs behind, and, if still followed, attempts to fly, and so well imitates the motion of a bird wounded in the wing, that the intruder is easily misled, and the eggs remain undiscovered."

"The male has the forehead crossed by a broad band of white, which gradually diminishes to a point at the posterior angle of the eye; above, a band of black, which also diminishes to a point at the same place; from the angle of the mouth to the eye, a line of black, which is continued from the posterior angle of the eye down the sides of the neck; crown of head, nape, and back of neck, rich rusty red; all the upper surface and wings pale brown, each feather margined with a still lighter tint: primaries, blackish-brown; the shafts and extreme edge of the inner webs white; four central tail-feathers dark brown, the remainder white; all the under surface white; irides very dark brown; bill dark reddish brown; naked part of legs above the tarsi dark greenish grey, tarsi light grey; feet blackish brown."

The example before us is probably an accidental straggler to our shores from Australia, it is, however, a very interesting addition to our list of New Zealand birds.

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* Vol. II., p. 235.

Art. XXIII.—*Remarks on some curious Specimens of New Zealand Birds.* By T. W. Kirk, Assistant in the Colonial Museum.

[*Read before the Wellington Philosophical Society*, 11*th October*, 1879.]

It will be remembered that, in 1876, Dr. Buller read before this Society descriptions of several varieties of the Common Wood-Pigeon (*Carpophaga novæ-zealandiæ*). I have now the pleasure of bringing under your notice two additional examples of albinism in this species.

No. 1 is a beautiful albino, the whole plumage being pure white, with the exception of the lesser wing-coverts, which are a delicate yellowish-brown colour, but much more decided than in the specimen mentioned by Dr. Buller. The claws are yellow instead of black, which is the normal colour. This specimen was shot at Springhill Station, Upper Whareama, by Mr. A. Cameron, and by him presented to the Museum; he says it has frequently been seen about the station during the last four years.

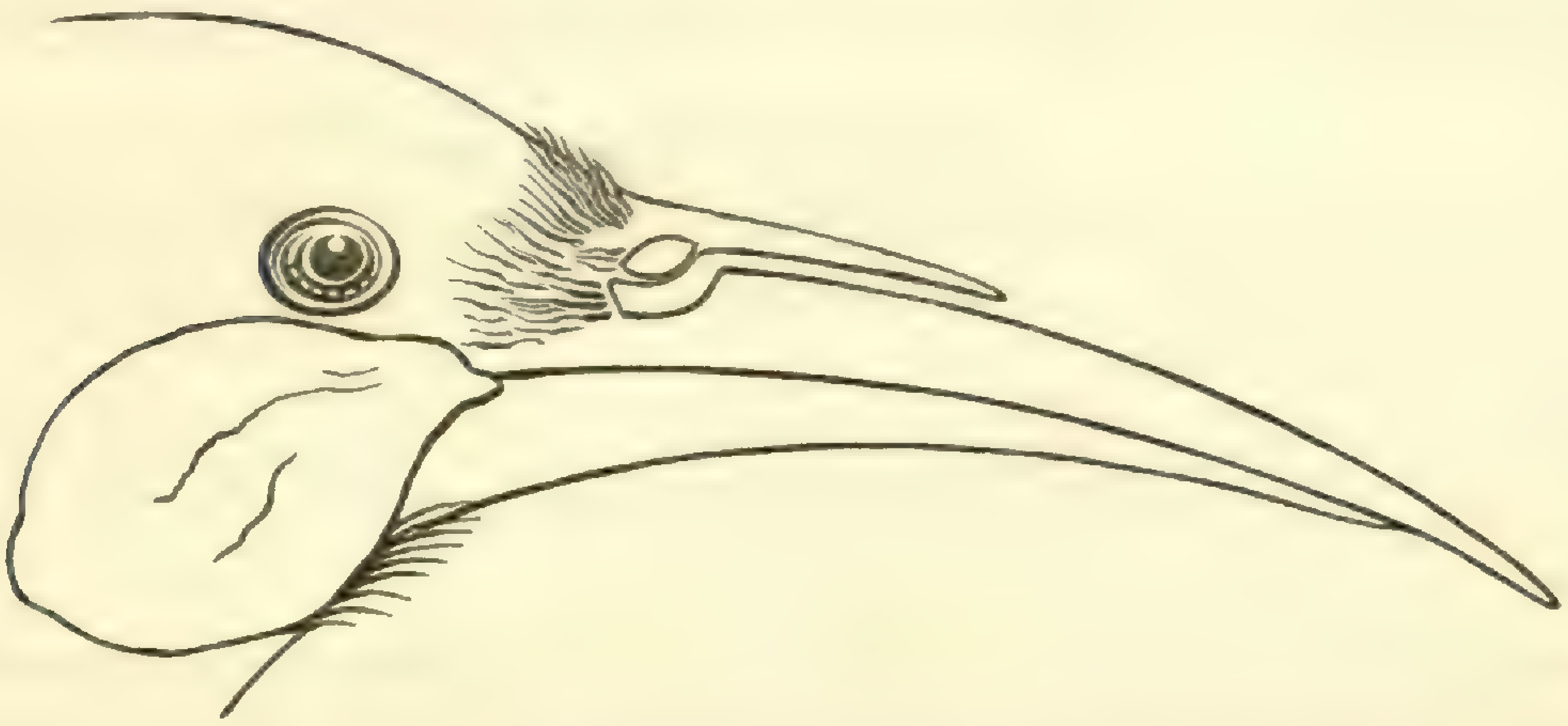
No. 2 is a partial albino. The head, neck, back, and fore-part of the breast are light brown, stained in places with coppery-purple; lesser wing-coverts, coppery-purple; quills and their coverts, light brown; quills tipped and margined with white. Tail-feathers brown, tipped with white; under-surface steel grey, changing to brown towards the extremities; under-parts from breast downwards, white, slightly tinged with brown; eyes and feet the usual carmine pink; claws yellowish-pink, tipped with black. This specimen was procured at Pahautanui, and presented to the Museum by Mr. Wise, a very old resident in the district.

The next specimen I have to draw your attention to is a curious and interesting variety of the *Kotuku*, or White Heron (*Ardea syrmatophora*).

On the right wing, near the "bend," is a patch of dark feathers; thence a band of black and brown passes right over the back and joins a much larger patch of the same colour on the left wing, and then extends obliquely across the breast, becoming fainter as it again approaches the left side. Inner webs of primaries, lining of wings and flank-feathers, more or less marked with brown, passing in places into black. A black patch about an inch in length will also be noticed on the outer web of one of the "secondary plume feathers."

I have never before heard of a specimen of this species possessing a single coloured feather, and indeed I am informed that "White as a *Kotuku*" has passed into a proverb amongst the natives. I was therefore surprised, when, on proceeding to examine the six specimens contained in the "type collection," in the Colonial Museum, I found that no less than three of them had the wings, especially the under-surfaces, more or less spotted or dashed with brown and black.

The accompanying sketch represents a curious deformity (if I may use the term) in the bill of a female *Huia* (*Heteralocha acutirostris*), now in the



Museum collection. It is evidently the result of an accident, and from its appearance I should say that a shot had just passed below the nostril, splitting the bill in the manner shown. The left side of the upper mandible has also been broken off, but this was evidently a subsequent misfortune, as the broken edge is still somewhat sharp; while the top of the bill and "spike" are smooth and polished. This unfortunate bird was presented to the Museum several years ago, by Mr. J. D. Enys, who shot it at Akitea.

Art. XXIV.—*Notes on the Nesting Habits of the Orange-wattled Crow.*

By W. D. Campbell, Assoc. M. Inst. C.E., F.G.S.

[*Read before the Wellington Philosophical Society, 27th September,* 1879.]

The nature of the nesting habits of the *Glaucopis cinerea* (Orange-wattled Crow) have been as yet entirely unknown, and the author, having chanced to find, towards the end of February last, two nests of this species near the Ko-i-te-rangi hill, on the Hokitika river, forwards the following description of them.

The nests, which were 15 inches externally, were somewhat loosely constructed of twigs and roots, and had well-formed cup-shaped interiors, lined with pine roots and twigs; they were built in the branches of the *Coprosma*, or "black" scrub, which grows upon the low river-flats of Westland, near the mountain ranges. The average height of the scrub in this instance was about 15 feet, while the nests were about 9 feet above the ground, and 200 feet distant from each other; one contained an egg, the other, two nearly fledged birds. The egg has been presented to the Colonial Museum. The two young birds were kept for some weeks in a cage for the

purpose of studying their habits; their wattles were of a light-rose tint, changing into a violet colour towards the base, but after death, when their skins were dried, the wattles assumed a dull orange tint. The parent birds had wattles of the usual rich crimson-lake colour, the base being tinted with violet as in the young birds.

The egg has almost similarly rounded extremities. Length 1·7 inch, breadth 1·1 inch; the under tint of the egg is brownish, mottled with grey and dark brown blotches which are larger and darker at the larger ends.

ART. XXV.—*On the New Zealand Frog.* By Dr. FITZINGER. Translated from the Zoology of the Voyage of the "Novara," by Professor Hutton.

[*Read before the Otago Institute, 14th October*, 1879.]

Family *Bombinatoridæ.*

AUDITORY passage imperfectly developed; transverse processes of the sacral vertebræ triangular, flat; no paratoids. (Fingers and toes not dilated at the tips; maxillary teeth).

Genus *Leiopelma*, Fitz.

Tympanum, sacs, and auditory tubes wanting; teeth in the upper jaw, and in two faint oblique rows on the palate, behind and between the interior nares. Tongue roundish, more or less margined. Fingers free. Toes half webbed. Projection of the navicular bone small.

L. HOCHSTETTERI, *Fitz. Verhandl. d. zool-bot. Gesellschaft zu Wien, Jahrg 1861; XI; pag. 218, Taf. VI.*

Body moderately compressed. Eyes rather large; muzzle rather longer than the eye; exterior nostrils rather nearer to the eye than to the end of the muzzle.

A glandular fold between the posterior corner of the eye and the shoulder; a second from the eyes, along the sides of the body to the thighs. Several warts about the corner of the mouth, and a few smaller ones on the back and on the sides of the rump. Two smooth, yellow callosities on the palm of the hand, one on the metacarpus of the thumb, and one near that of the fourth finger. Fingers and toes depressed. Toes connected by the web for about half their length, the free part bordered by the membrane. Projection of the navicular bone faintly elevated. A dark-grey triangular band between the eyes, in front of which is a broadish and lighter oblique stripe; hind limbs with broad cross bands on a yellowish-brown ground. Belly and sides of rump dirty grey-violet, marbled with yellowish-brown; a

light oblique streak running down from the anterior and posterior corners of the eye, and diverging to the rim of the upper jaw. Male without sound-bag.

Coromandel, near Auckland.

ART. XXVI.—*Notes and Observations on the Animal Economy and Habits of one of our New Zealand Lizards, supposed to be a new Species of* Naultinus.

By W. COLENSO, F.L.S.

[*Read before the Hawke's Bay Philosophical Institute, 12th May*, 1879.]

HAVING had ample opportunities, during the past year, of observing the habits and manners of these elegant little animals in a state of captivity, and believing all such to be almost wholly unknown, I have thought it desirable to give a pretty full description of the same; seeing, too, that I succeeded better in rearing and keeping alive these lizards than I did with the larger one, *Hatteria punctata* (or *Sphenodon*), in 1840.

In the winter of 1878, I received a glass jar from Hampden, in this provincial district, containing three full-grown living green lizards. They were pretty nearly alike in size; two of them were spotted with large irregular-shaped light-green spots, or markings, and one was wholly green. They had been found together, a short time before, in a hole, with a fourth, which was accidentally killed; and, on their capture, were put carefully into a jar, and packed loosely in moss. On my receiving them I found them apparently very well, but unwilling to move or to face the light, seeking to bury themselves more and more in their mossy bed, so I left them alone, believing they were hybernating. Meanwhile, I made many enquiries, by letter, as to their "hole," its linings, etc., but gained little reliable information, save that "in it, and with them, was a lot of stuff like blasting powder;" this, I have reason to believe, was the fæcal debris. I greatly regretted the loss of the fourth, as I think that would have proved to be a green male.

During the winter I looked at them three or four times, but they always acted in the same manner, as if averse to having their quiet sleep disturbed. On again looking at them early in October, I found them wholly altered; they were now desirous of coming to the light, restless, and pawing against the glass, and had increased in number, having four little ones! two being spotted with white, and two entirely green; their lovely little bodies looking as if cased in silk velvet instead of scales; this appearance continued for some weeks. I now lost no time in removing them to more suitable

lodgings, placing them under a circular glass dome, of 10 inches diameter, with a few leafy twigs of koromiko (*Veronica salicifolia*), and giving them water in an oblong flint-glass salt-cellar, which, from its form and thickness, they could not upset. I knew they must be hungry, and I tried them with several things in the way of food, as bits of meat, both raw and cooked, of various fruits, of bread, of succulent roots and vegetables, and with small larvæ (caterpillars), but nothing would they touch. At last, as the warm weather came on, I tried them with a few flies, which were killed, or made motionless, in catching, these, also, they would not touch, or even look at. At length I put some living flies into their crystal palace, and these they soon caught and ate—that is the three adult lizards. For a long time I sought in vain for very small tiny flies for the young ones, and when I did succeed in getting a few, it was some time before the baby lizards managed to catch and swallow any (although the little things pursued them with longing eyes!) as the fly, when caught, in struggling, would often escape out of their tiny mouths, which was the more easily effected through the lizards not having any teeth to hold by, and the powers of the young ones were but feeble through their long fasting. One day I happened to give them three or four of the large red-brown viviparous flesh-fly (*Musca læmica*), thinking the large lizards, at least, would now have a good meal, and when I was not a little surprised to see them scuttle about in all directions, wholly turning away from these flies, and apparently endeavouring to hide themselves (or their heads) among the koromiko leaves. For some time I did not understand this new movement, and I subsequently noticed, that while some of these red-brown flesh-flies were eaten (being gone), others were left dead on the floor of their cage.

Early in November I was sorry to observe that the young ones, although all four had grown rapidly in length, were daily becoming more weak, especially the two entirely green ones; this, of course, was owing to their not eating. On the 3rd of November one of the young green ones died. At this time, too, the head of one of the adult lizards (as I believe, the female one) swelled much, changed to a livid colour, and grew to an unshapely size, with a bloody discharge distilling from its ears. I thought, that something being the matter with its head, the other lizards in their scrambling about over each other (which they commonly do) had fixed their sharp claws in its ears, being now tender, and so caused them to bleed, &c. The sick lizard, however, was very patient under it; and as its disorder increased, the skin of its head became more and more stretched with the swelling, and great and irregular throbbings or undulations were very apparent. (Here I should mention, that the regular pulsation in their throats is always prominently seen). And so, as this diseased lizard became

offensive, yet still living (though not eating), dirtying the others with its discharges, *anal* now as well as *aural*, I threw it out into the field.

On the 16th November I looked at my lizards, as usual, in the morning before going to town, and found them right; but on my return, at one o'clock, p.m., the biggest spotted one (which I believe to be a male) had cast its skin!—or epidermis!—it was nearly all got off, and almost entire. I helped it, by holding its scurf, to draw out its tail. I was much pleased at this for several reasons—some I may here mention: (1.) The beautiful new sparkling vivid green colour of the animal! now, for the first time seen in its living beauty. (2.) The cast-skin, or scurf, truly a curious object; showing, not only every scale, and joint, and spot, and marking, including the little fingers of its tiny gloves close down to its claws; but, also, the very outer skin or film of its labial scales, and of its eyes. (3.) The cast skin was not at all coloured green like the animal, but was merely of a light grey colour with lighter patches corresponding with its large white spots. (4.) It had commenced breaking away under the chin, and so peeled off from its snout regularly down its back and body to the tip of its tail. (5.) I might now expect to know something certain of this animal's economy (and of its congeners), as to how often in the year it would cast its skin.

One of the spotted young ones (which I shall term No. 1.) also cast its skin on the 6th December; like that of the large male it commenced at the snout, but it came away in fragments—perhaps owing to its being both young and tender.

On the 8th December the second young green lizard died, just as the former young one died, from starvation. This one had, in common with the two young spotted ones, plenty of small flies (now more easily obtained as the summer advanced), but it wanted the power to catch any.

About the 12th December the two remaining adult lizards seemed to be getting into a diseased state; the handsome male, which had so lately shed its outer skin, had something the matter with its ear, from which a bloody discharge was oozing (resembling in a smaller degree the early diseased state of the adult one that died), while the adult female was restless, swelled in the lower abdomen, and discharging a bloody mixture from its anus; finding this one getting rapidly worse, with its anus greatly swelled and blotchy—starred all round the margin as it were in a curious regular manner—I lost no time in putting it into a bottle of spirits, and, on my going to look at it some ten minutes after, I found, to my astonishment, no less than 26 large living larvæ of that red-brown flesh-fly had been discharged from its anus! These were each 5 lines long, and it was their posterior ends compacted together and jutting out from the lizard's anus which had given it in that part its peculiar appearance. Now it flashed across my

mind,—their evident dislike and dread on their first seeing that flesh-fly in their cage; and that this was also the cause of the death of my first lizard, into which the living larvæ had been deposited through its ears! causing its head to possess and show those ugly, unnatural throbbings or semi-undulations. I now hastened to the adult male lizard, and caught it, and on gently squeezing its head I saw the posterior end of a larva presenting itself within its ear; I took a needle and extracted it; it was much larger than those in the spirits, and gorged with blood. After this the male lizard soon recovered and became lively, though that aural orifice completely closed up, and so remained until the next shedding of its skin, when I was glad to find that it resumed its former appearance. From the time of this discovery I was careful not to give them any more viviparous female flesh-flies, consequently I have had no more similar diseases to notice.

The other young spotted lizard (No. 2) shed its skin for the first time on the 16th December, taking, however, until the 22nd ere it entirely got it off. This little animal interested me much in its undergoing its change of dress; for as the other young one (No. 1) had taken me by surprise, in its early disrobing, I had closely watched this one (No. 2), supposing its turn could not be far off; and first I noticed, that the day before that it began to cast its skin, its whole body assumed a whitish milky appearance, as if it had been dipped into milk and the milk had dried upon it; or, as if it were closely covered with very fine and transparent white muslin; second, just as in the case of the others, the epidermis first broke at the snout and chin, and subsequently gave way over the loins and hind-legs, peeling off in large flakes. After a day or two the lizard seemed to get impatient about the getting-off of its old coat, and every now and then would lay hold of the rags with its mouth and pull away, and sometimes try to force them off with its little claws, but I scarcely ever noticed that it effected anything; it would rub, too, against its water-pot (the salt-cellar), and sometimes against the large lizard, and the koromiko stalks—showing clearly that in their natural state they seek the aid of closely-growing grasses and other small herbage the more quickly to effect their deliverance; at last, on the 22nd, I caught the lizard, and helped it to get off its tattered stockings, gloves, and tail-case, and so put an end to its discomfort.

The big male lizard again shed its skin on the 24th January; this time, however, in fragments, yet done quickly, all being over within two hours. And again this lizard shed its skin on the 15th of March, this time in large pieces; finding that while it had extricated its hind-legs it could not draw out its tail, I caught it and helped it to do so. It was pleasing to see how quietly it remained in my hand, when it found out what I was doing, and how naturally it moved its long tail in an easy wriggling manner, and with

strong muscular power pulling against me, so that the whole outer skin of the tail came off, as at first, in one unbroken piece. The cast skin is damp, soft, and slightly clammy, on its being shed, but it quickly dries and hardens.

The young lizard (No. 1) next cast off its skin on the 31st December, having assumed the milky appearance already mentioned the day before; and to my great surprise this same lizard again put on the cloudy milky appearance on the 13th January, and again shed its skin on the following day when its scurf was just a fortnight old! As before, it began to break away at its snout, but on this occasion, somehow, possibly owing to its fineness, it got rolled up together and backwards behind its eyes, giving the animal with its white wig the drollest appearance imaginable, so that I often laughed outright! This time it was very slow in casting off its rags, as parts of its skin were still hanging on its sides on the 24th January—just ten days —when I caught it and helped it. This lizard again shed its skin on the 1st March, when it was two days in getting it wholly off: often biting it and tearing at it with its claws. The next time it did so was on the 19th April, having assumed the usual milky appearance two days before; on this occasion its old scurf first broke through over its back.

The other young lizard (No. 2) again cast off its outer skin on the 5th February, having the day before put on the peculiar milky appearance.

So that, during the past seven or eight spring and summer months, those three lizards have each shed their epidermis as follows:—

Big adult male, 1878, November 16; 1879, January 24; March 15.* Young one, No. 1, 1878, December 6, December 31; 1879, January 14, March 1, April 19. Young one, No. 2, 1878, December 16; 1879, February 5.

Their manner of taking their prey (flies) is peculiar: When the lizard clearly sees the fly, and makes sure it is living, it steals towards it in the most stealthy manner. As the lizard nears the fly, and when within two inches of it, then is the time closely to notice its actions. First it arches its neck to a tolerably sharp angle, and its eyes swell and bulge out, or rather upwards, over their orbits, and the expression of its countenance alters greatly, taking on a fierce look; next it lifts its little hand-like paws and moves them, only a toe or a finger at a time and often in the air, very slowly and cautiously (much like a little child does its hands when stealing along on tip-toe), and then it nears its head towards its prey, but so very slowly that I have better detected its movement by watching its shadow cast on marked paper by strong sunlight,—reminding me of the almost imperceptible movement of the hour-hand of a clock. At last it has got to

* *Vide* Addendum.

about one inch, or a little less, from the fly, when as quick as light the dart is made, and the fly is caught; and then the little lizard rapidly knocks about its prey from side to side as a terrier with a rat, not however striking the fly against anything, merely shaking it. After a short time so spent the lizard proceeds to swallow the fly, which it does by half opening its mouth and drawing it in, and generally, after three or four movements of this kind, the fly is gulped down whole—legs and wings and bristles! Notwithstanding its struggles, I have been surprised at two things here: (1.) that it does not matter how the fly (or moth) is seized, whether by head or tail or side, down it goes, in despite of its long legs and wings; and (2.) that such a very small throat as the young ones have can so readily swallow a tolerably large fly (or moth) whole, and that, too, without showing any outward distention of the throat beneath; for although it keeps its head elevated, you cannot trace the prey going down the lizard's gullet! The larger adult lizards, however, do not knock about their heads with their prey in their mouths; they just give the usual two or three movements of their jaws, and the fly is swallowed! Sometimes it is one of the largest "blue-bottles." And the young ones, I notice, do not now knock about their heads when they have seized their prey so much as they did at first. On two or three occasions, when flies have been rather scarce, and the little lizards hungry, I have seen when one had got the fly into its mouth, the other would make up towards it, arch its neck, and put on the usual ferocious look, and, watching the time when the lizard with the fly in its mouth should open its jaws to make its swallowing movement, dart forwards and lay hold of the part of the fly outside of the mouth of the other. And now they both hold on to the fly—the fly getting the worst of it between them—and sometimes one and sometimes the other gets the prize; and, on more than one occasion, I have seen the fly get away from them after all its pinching! and fly and crawl about a little longer; showing that so far it was not greatly hurt. They often miss catching the fly when they make their dart upon it, for it flies away when the lizard looks stupidly about; the escaped fly flies around the glass, and sometimes comes back to the same spot or nearly so, and not unfrequently alights on the lizard's snout! When it does this, the lizard does not seek immediately to recapture it, and sometimes it even turns and runs away from the fly! On several occasions, when a fly has got into their water-trough, and is there struggling, I have seen them climb up and make a dart at it, and so take it in the water. I have mentioned moths. On a few occasions, when without flies, I have given the lizards a moth or two, of from 1 inch to 1½ inches in length, and the lizards would catch and eat them just as they did flies, but the down would stick to their lips for some time ere they managed to swallow it,

which they also did. The large lizard often puts its tongue out ("licking its lips") when it goes after a fly, especially if a big one; I am inclined to think that it is hungry then. It is pretty to see the two young lizards going together after the same fly, especially if the fly is crawling above them, within, on the glass roof; to see them walking slowly, side by side, with measured gait, and step by step, like a pair of hounds in a leash or a couple of miniature fairy-like little creatures, with their heads up, and their little black eyes glistening; at such times, too, when they at last near the fly, they often trample on each other in their eagerness, but whenever they do so, they always take it very quietly, the one underneath neither struggling nor retaliating.

It has often seemed to me as if it were a natural law, or rule, of these lizards (a thing understood by them), that whenever they trample on, or walk slowly over, each other, or stand, or lie, or even sleep on each other, the under one, or ones, always take it patiently, and rarely ever move at all—not even when the sharp claws of the upper lizard are pressing on the eyes of the one under him: I have often been surprised at this. I have never once seen them fight or fall out, or attempt to bite each other, although confined in so small a compass. They often spend hours lying on each other's backs, which is a favourite posture with them, and sometimes sleep, or spend, the whole night thus. I have seen the whole seven thus together in one lump, with, sometimes, the little ones underneath.

They don't seem very timid nor easily startled to any great degree with noises, or sights, or sounds. I keep them on the table in my sitting-room, at which I take my meals, etc., and I have often thrown down a newspaper by their side, or struck the table with a book pretty strongly, yet they never start; it is the same when the candles are lit. They appear, too, as if they liked to snugly ensconce themselves in their cage under the koromiko branch, or (the two young ones) stretched out at full length on the upper side of the twigs.

I believe them to be inoffensive, peaceful, and sociable; and if, as I have already surmised, the fourth one (which was killed) was also a male, then there would have been two couples, at least, hybernating together in one "hole;" or that "hole" may have been their usual dwelling-place, seeing there were found in it "*lots* of black stuff"—no doubt their dry and hardened fæces, which could not, I think, have been so largely deposited during the short period then passed of their hybernation. An intelligent friend in the country, who is also an observer of nature, has informed me that he has found them, in clearing, "six or seven together, cuddled up under the roots of a flax-bush" (*Phormium*).

It is pretty to see them drinking, which they do but seldom; they lap water much like a cat, but very slowly, as if they were tasting it; every now

and then passing their broad, thin, and large tongue right over their eyes, as if washing them, and always so finishing their drinking. I have also seen them lick the wet koromiko leaves when fresh; and the young ones, more than once, lick the adult male. Their tongue and palate are of a deep purple colour, much like that of some plums, and the tongue, when fully extended (as in licking), has an emarginate appearance, which may, however, be owing to the action of the hyoid muscle.

They seem to like the water, as they often go singly into their water-trough, and remain extended in the water for some time. They can swim very fast, too, but clumsily, as if they were in a great hurry about it; I have occasionally tried them at swimming in a large vessel of water.

They can run very swiftly, as I have often proved. When they merely walk, their tails are always straight; but when they make haste their tails are undulated laterally throughout their whole length. Here, no doubt, their under-squamæ help them; this, indeed, I have in a measure ascertained, in my taking the large lizard into my hands and holding it vertically, when, to aid its ascent in crawling, all the squamæ below are used strongly, and one feels them curiously applied against the hand.* This, also, I think, will account for their being able to climb up on the *outside* of their glass dome, which they can do—in which feat they are no doubt also materially aided by the large transverse scales on their toes, which are a beautiful object, and admirably adapted for climbing purposes. Their claws, too, are exceedingly sharp, having a translucent or semi-crystalline appearance, and are set on at almost a right angle to their toes. One can hardly bear to hold them in one's hand when they struggle and use their sharp claws.

Their tails have also a strong prehensile power, as I have found in their clasping my fingers with them very closely, and so holding on. On one occasion I had to clear the tail of one which was fast, having taken a half-turn over itself in the sharp angle of a twiggy branch of half-withered and flaccid koromiko, which, I suppose, it had pressed down by lying upon it.

They sometimes spring a short distance very nimbly when they wish to get away from any little obstructions; and they also jump down fearlessly and without hesitation. I have taken them up and allowed them to run over a book, etc., held horizontally, 2–3 feet above the table, when they would run straight over the edge of the book and drop on the table on all-fours, like a weasel or a cat, and so continue to run as before.

They assume all manner of curious and grotesque positions, some of them being most extraordinary, and some apparently painful, but in reality I suppose are not so. Whatever posture they assume they both can and

* The sensation being just as if every single scale was being forcibly moved forwards in rapid succession by the muscles of the animal.

do keep it for a long time, often remaining motionless for hours, occasionally even days, in one position. I have often thought, that if a correct drawing were taken of the lizards when in such queer postures, the cry of "How unnatural!" would surely be raised on its being looked at. Sometimes they will take a peculiar position on the edge of their water-trough (glass salt-cellar), there, with their tails within it, and merely holding on by their hind-feet on the narrow outer edge, they will project themselves forward in the air, and so either keep themselves quietly extended, or paw about in the air with their fore-legs, for some time. The large one will stand up against the glass dome (on the inside) with its fore-feet spread out on the glass, and its long tail curled in under it in a perfect ring, and its two hind-feet clasping its tail on the opposite side of the ring! Sometimes the young ones will raise themselves against the glass (within) and there stretch out their four paws on the glass, and so support themselves on their tail, which is for this purpose bent a little below its base, having the lower portion extended on the floor (much as a kangaroo is sometimes drawn) and in this posture they will remain 2–3 hours without moving. I have seen one of the young ones lay itself along the edge of its water-trough having its two feet of one side just within it, with the two feet of the other side low down on the outside, and its tail passed around the end and further side above the floor, and so remain immovable for half-a-day! I have also noticed one of them stretched among the koromiko twigs, having one of its little fore-legs twisted up backwards over its back! apparently as if dislocated or broken, and so remain for several hours. I have also observed the young ones standing for a considerable time with the 5th (or outer) toe of each hind-foot turned in completely underneath the sole from the first phalanx, so that no vestige of that toe could possibly be seen. The joints of their legs and toes seem to be strangely formed, as if reversible at their will in action. Sometimes one of the young ones will stretch itself on the head of the adult male, looking towards its tail, just bringing its four paws and sharp-pointed claws into the head and eyes of the large lizard by which it holds on! at other times the young one will quite reverse that position, looking ahead of the large lizard, but with its feet and claws as before (only reversed) and so remain for hours; the big one under him not moving. It is pleasing to notice them when a fresh leafy branch of koromiko is put into their cage, then the two small ones will climb up and extend themselves along the branchlets, while the adult lizard will curl himself up among the leaves below, and so they will quietly remain. On one occasion in the spring, when the whole seven were alive together, I noticed, one evening, one of the adult lizards on its side in the salt-cellar with its legs and feet as if twisted unnaturally over the edge; I first observed it about 5 p.m., at

8 p.m. it had not moved, so also it was at 11 p.m., when I went to bed, and when I came down the next morning it was still in exactly the same strange position; I now thought it could not easily get out, so I lifted the glass to help it, but the moment I did so it scuttled away very fast.

They always take a most peculiar attitude to void their fæces, which, however, they do not perform frequently. I always know when they are about to do so (if on the look-out), for with young and old their preparation is pretty much alike. They first lift up their tails in a semi-curvature towards their backs, then they lift their hind-feet from the floor, and so slowly void their one pellet; which done they gently lower their hind-feet, and then their tail, and move away. On one occasion I saw the adult male lizard, which was quietly at ease among the koromiko twigs, leave its lair and climb up into the water-trough; at first I thought it was going to drink, or to bathe in the water, but I was agreeably surprised in noting its actions; having got into the salt-cellar, it placed its feet on both sides, cocked-up its big tail, and voided its pellet into the water! That over, it leisurely descended to its former resting-place. In their voiding the fæcal pellet the anus of the animal is produced much more than would be supposed. Their dung is of a long oval shape 4–5 lines long, and not unlike that of a sheep; it is black in colour, but always with a white adjunct (uric acid), somewhat resembling that of a fowl, which portion always appears first; they void rather slowly. Sometimes, especially after eating "blue-bottle flies," the portions of the fly in rather coarse fragments are very plain in the deposit.

It was highly curious to note what I believed to be the amorous manner of the adult male toward the female lizards. This happened early in the summer, but the loss of the two females (*supra*) of course put a stop to it. He would chase the female in a peculiar strutting manner round and round their cage, moving his head horizontally very regularly and constantly with a jerk from right to left, and left to right, until he should lay hold of her, which he invariably did by the loose skin on the nape of the neck, when, having so caught her, he was still—sometimes for half-an-hour or more—holding quietly on all the time, but on her trying to get loose, which she easily did, the same kind of pursuit would follow, to be ended in a similar way. As the summer advanced his teasing manner became so constant, and evidently to the annoyance of the two females—giving them all no rest in their little cage—that I had thoughts of removing him into another, which I suppose I should have done had the two females not died.

Although I have often handled and stroked them, only on one occasion did one of them bite me; this was the adult male, and I had teased him a bit,—but his bite was but a gentle pinch, scarcely perceptible! I have a

growing fancy that they know me, for now they often come to the side of the glass nearest to me when I am observing them, particularly the two young ones,—this they did not at first. Indeed it is interesting to watch them, when I have them in their glass cage on my writing-table, close to me, when engaged in writing, to see them come to the side of the glass nearest to me, and there paw the glass, or stand up quietly on their hind-legs against it, evidently watching me closely with their pretty bright eyes, sometimes turning their little heads just as I may move. Of course they will not take a fly from my hands, for, let them be ever so hungry, as I have said before, they must see the fly moving before they will touch it.

I believe them to be endowed with great powers of abstinence; I scarcely ever saw the two adult females that died take a fly, and I am sure they could not have had many during the months they were in confinement, yet they did not fall off much in size; so with those two young ones that died,—one of them never ate at all from its birth,—yet, they continued to grow in length, just as the other two young ones did which survived. The adult male has rarely ever eaten much, sometimes (as far as I know, and I have watched him closely) scarcely three flies in a week. On one occasion, however, in the summer, I saw him eat four large red-brown flesh-flies within ten minutes, as fast as I caught them singly and put them into the cage; this feat quite surprised me as I had never seen anything of the kind before or since. The two young ones will each now eat half-a-dozen of the common introduced house-flies in a day, but then, after doing so, they go some 2–3 days without eating; each of them certainly eats more than the adult, although they are not one-fifth of his size. I generally feed them twice in the week. Of the various kinds of flies I have given them, I think they prefer a shining green-bodied one (which is scarce), also a *small* kind of "blue-bottle." I do not suppose they live on flies when in their natural habitat, rather on small *Coleoptera*. Their patience also, as I have already intimated, seems very great; speaking generally they like to remain in a quiet attitude, especially the adult; he, however, might also be widely different if he had a mate.

Cold-blooded as they are (and they do feel cold when handled), yet I think they like the heat of the sun; for when I place their glass cage in its rays they never seek to evade them. The pupils of their eyes, which normally are of a narrow lenticular shape, in strong sun-light contract to a mere line, like those of a cat; they dilate, however, when about to seize their prey, also by candle-light, but not much, the pupil never becoming full. Their eyes also appear fixed, so that I believe they cannot see any small object (as a fly) when straight before them and pretty close to their nose. I have not detected their possessing any sense of smell, and have

reasons for believing they are devoid of it. I have also never heard any cry or sound,* though the ancient New Zealanders would flee in terror from this animal (or an allied species, *N. elegans*), saying they had sometimes heard its cry, which they called *kata* (= laugh), which they also greatly disliked and considered ominous. But, though I have often seen *N. elegans* on shrubs, etc., in travelling in former years, I never myself heard its cry; possibly, it may only emit a cry at certain seasons. I should also mention that these lizards have had many opportunities of uttering a cry, if, like many other animals, sudden pain would extort such from them. For, in spite of all one's care, sometimes one of them will get its toe or tip of tail slightly caught in replacing the glass, when it twingles and twirls surprisingly until it is released, when it runs and jumps wildly around its cage for a few seconds—no doubt from pain—but it never makes a cry nor opens its mouth. In this way one of the young ones got its tail hurt, during my absence from home in the summer, and, although apparently it was only bruised, about 8–9 lines from the tip, it has not yet assumed the normal healthy appearance, and I much fear the tip may fall off; it has also lately lost part of one of its hind outer toes from the same cause.

I advance this as a new species of *Naultinus* with some degree of doubt; but it does not agree with those several descriptions of the various species of that genus in "Trans. N.Z. Inst.," Vols. III. and IV., neither with the drawing therein given, said to be of *N. punctatus*, the outline of which is different. Should, however, this one here described be found hereafter to belong to one of them, then its specific description, as there given, will have to be amended.

Naultinus pentagonalis, *Col.*

This species is distinguished from its two nearly allied and described species (*N. elegans*, and *N. punctatus*), by its larger size, longer toes, form of scales, number of inter-nasal shields, etc.

Front of head, flat, somewhat depressed; eyes, large, broadly orbicular, very prominent in the upper region; the fine scales of the infra-orbital fold, or ring, protruding causes a ciliated appearance; aural apertures, large, elliptic; a strongly-marked median line, or groove, runs from the base of skull nearly to the end of tail; a large protuberance, or hemispherical swelling, immediately behind the vent.

Scales on body and legs most regular and pentagonal; those on lower part of head, towards the snout, and between chin and throat, and behind vent on the swelling, are much larger than those of the body; at base of tail, on each side of its junction with the thighs, and near the vent, are seven large transverse conical-pointed scales, in two rows, $\frac{3}{4}$, those of the

* *Vide Addendum.*

upper row the largest, and one on one side bifid; (the two young ones are also each showing a row of three transverse conical scales at base of tail); a large semi-circular patch of pre-anal pores, continuous, in three rows of scales, on both sides, in a long line ($\frac{3}{4}$ inch), under thighs; scales on tail imbricated, particularly towards the tip, where they are also smaller and slightly elongated; three inter-nasal scales; labial scales large, $\frac{8}{10}$, gradually decreasing in size, that on the snout largest and emarginate, that on chin same size.

Toes, long, narrow, fine, those of hind-legs nearly twice as long as those of the fore-legs, last three the longest, and about equal in length (5–6 lines), while the fourth toe is the longest of the fore-leg; toes with large transverse scales, but the middle (palm) of foot has granular-like scales.

General colour,—*adult:* bright emerald green, with large oblong irregular-shaped spots or splashes of dull white, diminishing in size in two broken but parallel lines running from head to tail, one on each side of the back bone; tip of tail, pink; belly, yellowish-green; labial scales on both lips, light green of one hue; mouth, throat, and tongue (of both old and young), dark plum colour between purple and port; feet, tawny-white, or light cinnamon colour below. The *young* ones are marked each with about ten pairs of pure white irregularly-shaped spots, and nearly opposite, in two parallel lines running from head to tail, half of their number being on the body; one has a semi-circular white streak, 3½ lines long on both sides of its head over the posterior angle of the eye and ear; and one has two additional longitudinal rows, one on each side, of minute whitish spots; labial scales of under-lip, white; belly, light pea-green.

Length of adult, 7 inches 2 lines, of which the tail is nearly 3.6; of the young ones (one year old), 4 inches. The yonng, when first seen, were a little over one inch in length.

ADDENDUM.

Having obtained a few additional items of interest concerning those lizards since this paper was read, I give them here.

Those lizards commenced hybernating early in July. Possibly they would sooner have done so, but I had kept them in my sitting-room, where there was a daily fire; when, finding they did not care for food (flies), and remained still, I put them away in a dark back room, placing some soft hay in their house. They remained there until the 1st of October, when I brought them back—apparently thinner for their long fast, but healthy; the two young ones had also grown in length. They soon began to catch and eat flies as before. From the very small amount of fæcal deposit found in their cage, I could not but think that the hole in which the original four were found must have been an old and often-used haunt.

On ths 16th November, the young one, No. 2, cast its skin, much broken. (This one only shed its skin twice during the last summer.) On two occasions since, I have seen it have a kind of convulsion fit—once in its cage, and once on my hand—during which its writhings were strange, as if its little legs were disjointed; its head was thrown back and its mouth stretched wide open, showing its capacious throat; it also uttered two faint cries during the fit, and once tried to bite!—but such a little easy nip, scarcely perceptible.

The adult one also, while I was handling (examining) it, bit me—in its fashion!—and twice uttered a cry because it could not get away. Their cry was a grave sound, a little low croak, something like an attempt on our part at uttering the letter *a* (broad) with the mouth open.

I have since fully proved the strong prehensile power of their tails; they can hold on by them to a cord, or small branch, or to my finger, and thus suspend themselves for some time.

An acquaintance here looking at them observed, that he once saw two green lizards (*Naultinus* sp.) together near Auckland; in endeavouring to capture them, one got away among the fern, and the other was unfortunately killed. He, however, noticing that its abdomen was very large opened it, and found two small living lizards within. This statement strengthens me in my supposition that this lizard is viviparous.

The adult lizard is now casting its skin in the usual manner (November 26th).

Art. XXVII.—*Description of a new (?) Genus and Species of Butterfly of the Sub-family* Satyrinæ. By R. W. Fereday, C.M.E.S.L.

Plate IX.

[*Read before the Philosophical Institute of Canterbury, 5th June,* 1879.]

Erebiola, nov. gen.

Antennæ, the club much narrower and longer than in *Percnodaimon pluto*, but not so narrow or long as in *Erebia blandina*. *Eyes*, naked. *Labial palpi* rather longer, and densely clothed with much longer stiffish hairs than in *P. pluto*; the hairs of the tip forming an obtuse-pointed pencil. *Body* and *legs* clothed with rather longer hairs than in *P. pluto*.

Wings entire. *Primaries* rather more elongate, and hind margin more oblique than in *P. pluto*; the nervures and discoidal cells of both the primaries and secondaries very similar to those of *P. pluto*; except that in *P. pluto*, the first (*c*, fig. 3) sub-costal nervure is absent, and the space

between the externo-medial (*a*, figs. 2 and 3) and innermost (*b*, figs. 2 and 3) sub-costal nervures,* at their junction with the vein closing the discoidal cell, is rather broader than in *P. pluto;* none of the nervures dilated at the base.

Type—E. butleri.

The accompanying diagrams (plate IX.) represent:

Fig. 1. The disposition of the nervures in the primary wings of *E. blandina.*
2. Do. do. do. do. *P. pluto.*
3. Do. do. do. and secondary wings of *E. butleri.*

and are given for comparison; the figures enlarged to two diameters.

Not having the descriptions of all the genera of the *Satyrinæ*, I should hesitate in forming a new genus for this insect; but, as "the lower radial of primaries emitted above the angle of the discocellulars instead of below it," is given by Mr. Butler† as one of the distinctive characters of his new genus *Percnodaimon*; and as the now-describing butterfly has the like character, but disagrees with *Percnodaimon* in the form of the club of the antennæ, and the presence of the first sub-costal nervure;‡ I may reasonably assume that it differs from all the other genera, and have therefore ventured to describe it as a new genus.

Erebiola butleri, sp. nov.

Primaries: Upper-side smoky black; a white-pupilled black ocellus between the externo-medial and innermost sub-costal nervures, and equidistant between the discoidal cell and hind margin. *Under-side* ferruginous, suffused (except the apical and hind-marginal area) with slaty black; ocellus as on upper side; a sub-hind-marginal row of four whitish marks, the two nearest the apex being the more distinct and silvery, followed by a dusky shade on their outer margin.

Secondaries: Upper-side smoky black; a transverse row of three minute white dots near the hind margin; the dots arranged in a straight line pointing towards the anal angle, and situated respectively between the externo-medial, subexterno-medial, interno-medial, and subinterno-medial nervures. *Under-side* ferruginous, suffused with a dusky shade from the base to the transverse row of spots; a longitudinal discoidal streak of silver; a transverse row of three silvery spots near the hind-margin, followed by two small longitudinal silvery streaks near the anal angle; also,

* The Orismology in Kirby and Spence's Introduction to Entomology (the only authority I have) is followed in describing the nervures.—R.W.F.

† Ent. Mo. Mag. XIII., p. 152.

‡ As Mr. Butler does not mention the absence of this nervure in describing his genus *Percnodaimon*, I imagine he must have overlooked it.—R.W.F.

a small longitudinal streak of silver between the latter streaks and the base of the wing; the transverse row of spots consists of a conical spot—between the externo-medial and subexterno-medial nervures, with its apex pointing to the hind-margin; a sagittate spot between the subexterno-medial and interno-medial nervures; and a similar one between the externo-medial and subexterno-medial nervures, all bordered internally with a dusky shade; the latter two spots pointing towards the base of the wing, and each followed towards the hind-margin by a small silvery dot, between which and the hind-margin is a small silvery point, edged externally with black; a small pale, irregular subcostal mark near the base of the wing; and on the costa, two-thirds from the base of the wing, a larger pale triangular mark, followed by two pale irregular spots.

Male and female alike, except in size.

Expanse of Wings: male, 18¼ lines; female, 20 lines.

Habitat: Whitcombe's Pass, Canterbury, New Zealand.

I have described this butterfly from three dilapidated specimens brought to me by J. D. Enys, Esq., who has favoured me with the following account of their capture:—"I caught the three butterflies on Whitcombe's Pass, up the Rakaia, on the 8th of March, 1879. The Pass is over 4000 feet, and the first of the butterflies was caught close to the top; the others were near it. They were knocked down by my hat and put in paper, which must be my excuse for their state. They seemed to be rather slow in their flight, and were chiefly found on the snow-grass (of the family *Danthonia*) which covers the slopes of the hills at that height. I saw a number, but only got four."

In the accompanying coloured drawing (Plate IX.), figure 4 represents the male; *a*, the under-side; *b*, the upper-side.

I have named the butterfly after Mr. A. G. Butler, who has recently contributed valuable lists of, and papers on, the *Lepidoptera* of New Zealand, and to whom I am much indebted.

[Since writing the above, Dr. Julius Von Haast informs me that it was a specimen of this butterfly which he took in 1866 on Whitcombe's Pass, not of *P. pluto*, as he before stated (*vide* "Trans. N.Z. Inst.," Vol. IV., p. 217). Dr. Von Haast speaks from recollection, not having preserved the specimen he took.]

ART. XXVIII.—*Description of a (?) new Species of the Family* Leucanidæ, *and a (?) new Species of the Genus (?)* Chlenias. By R. W. FEREDAY, C.M.E.S.L.

[Read before the Philosophical Institute of Canterbury, 26th Nov., 1879.]

(?) Leucania sulcana, sp. nov.

(Plate IX., fig. 3′.)

Body, stout. *Thorax*, pale ochreous. *Abdomen*, extending about one-fourth of its length beyond the hind-wings; fuscous; the male with pale fawn-coloured tuft; pale fawn-colour beneath. *Antennæ* of male slightly serrated, and thickly ciliated. *Palpi* porrect, slightly ascending, extending considerably beyond the head; third joint slender, elongate-conical, about one-third the length of the second; thickly clothed; the second joint with long, and the third joint with short hairs. *Legs* rather stout; hind tibiæ with four spurs, each pair consisting of one long and one very short spur; the short spurs with a broad band of black hairs.

Fore-wings, pale ochreous, very sparsely irrorated with blackish scales, more especially in the regions of the postcostal and anal nervures, and apex; rather narrow, acute at the tip, outer margin oblique, a deep longitudinal depression extending from the base and running midway between the median and anal nervures to near the anal angle, the inner margin also being depressed, and the anal nervure running along the ridge between the depressions; a less deep longitudinal depression between the median and postcostal nervures; a brown shade runs longitudinally from near the centre of the disk to the hind margin, the shade inwardly dark and terminating abruptly at the median nervure and its third branch, and anteriorly fading away into the ground colour; a similar shade along the anterior side of the groove formed by the depression between the median and anal nervures; a narrow, dusky shade along the middle of the inner margin, and a short dusky streak near the base of the inner margin; the brown shades in some specimens incline to red, in others to yellow; margin of costa brownish-ochreous, inclining to reddish-ochreous in some specimens; along each side of the nervures, and also midway between the branches of the nervures, runs a groove; the grooves forming parallel striæ of ridge and furrow; the ridges pale and the furrows dusky; each central furrow terminating in a blackish marginal dot or point; the nervures rather paler than the disk of the wing; a blackish central spot at the apex of the acute angle formed by the fork of the second and third branches of the median nervure; a small cluster of blackish scales in the discoidal cell at the point where the third branch springs from the median nervure; the subterminal line represented by a blackish point on the first inner subcostal nervure,

about midway between the central spot and the apex of the wing, and a blackish speck on the anal nervure; the inner line by a blackish dot immediately below the postcostal nervure and close to its first branch, and a blackish speck on the anal nervure; and the half-line by a blackish dot between the postcostal and median nervures.

Hind-wings, bronzy-brown, with pale ochreous cilia.

Fore and hind-wings below shining fuscous, with margin of costa pale ochreous, and apex and hind margin of fore-wing inclining to pale ochreous.

Expanse of wings: 1″ 6‴—1″ 9‴.

Habitat: Akaroa, Canterbury; and Dunedin, Otago, New Zealand.

The only specimens I have seen were taken by myself in the month of February, at Sugar, in a small bush on the shore at Akaroa; and in a bush at Dunedin—at the latter place only one specimen.

The spurs of the hind tibiæ of this insect do not accord with those of any of the genera of *Leucanidæ*, as described in the British Museum List of Lepidopterous Insects;* and I might therefore not unreasonably consider myself justified in forming a new genus for this species, but refrain from so doing, inasmuch as Mr. Butler, of the British Museum, identified as *Leucania semivittata*, of Walker†, an insect having spurs similar to those of *sulcana*—at least so I infer from his having included *L. semivittata* in his paper "On two collections of Heterocerous Lepidoptera from New Zealand, with descriptions of new genera and species;"‡ the collections which formed the subject of that paper having comprised numerous specimens of my own collecting, entrusted to Mr. J. D. Enys for the purpose of comparison and identification with species in the British Museum; and amongst them were duplicate specimens, one of which was returned, labelled in Mr. Butler's handwriting, "*Leucania semivittata;*" and that specimen, and similar specimens in my collection, have the spurs of the hind tibiæ not "moderately long," as stated in the description of the genus *Leucania* in Walker's British Museum List, but each pair consisting of one long and one very short spur, as in *sulcana* above described.

(?) *Chlenias manxifera*, sp. nov.

(Plate IX., fig. 1′.)

Body rather stouter and more depressed that that of *C. egregia* of Felder. *Head* crested, as in *C. egregia*; white above, black in front; a small white tuft above the proboscis. *Proboscis* long. *Palpi* porrect, extending a little beyond the head, as in *C. egregia;* third joint white, slender, clavate (not conical), more (not less) than half the length of the second, rather naked;

* Walker, Lep. Het., IX., p. 68, *et seq.* † Lep. Het., suppl. ii., p. 628.

‡ Proceedings of Zoological Soc. of London, May 1st, 1877, p. 382.

R. W. Fereday, del. J. B. lith.

first and second joints hirsute, black. *Antennæ* of male pectinated; of female ciliated.

Thorax short, slightly crested; crest, tegulæ and patagia white, with the interstices black, and the hind margin of the crest black; pectus white, with a black tippet in front. *Fore-legs;* tarsi (except the ends next the tibiæ) black; tibiæ white, with black patches. *Middle and hind-legs;* tarsi (except the ends next the tibiæ) brown; tibiæ white, with brown patches; tibiæ of hind-legs, with four moderately long spurs. *Abdomen* silky cinereous.

Fore-wings elongate, *not* rounded at the tips; costa nearly straight; exterior border oblique and convex, except at tip, where it is slightly concave; pearly-white, with raised flecks; a black hastate patch at the base; a central irregular, and very erose fascia, extending from the centre of the costa to the anal angle; a similar submarginal fascia flowing into the central fascia in the middle of the disk; between the central fascia and the basal patch are two fasciæ, that nearest the base biflexed and terminating, *not* on, but near to, the inner margin, with the upper sinus bending outwardly, and the lower inwardly, and each sinus much swollen; the other fascia running nearly parallel with the central fascia, slightly sinuous, erose, and disrupted in the discoidal cell; the central and submarginal fasciæ, and the fascia near the base, pale India-ink colour, somewhat inclining to brown, with the margins shaded or blotched with black; several black blotches and spots along the inner margin; costa spotted with black quadrate spots, four of which are situated between the central and submarginal fasciæ, and those next the fasciæ generally confluent therewith; a row of five conical spots on the hind margin and extending through the fringe, the middle one being conical and smaller than the others, and the latter having their points more or less blunted or excised; a small black mark on the hind margin at the apex of the wings. Under-side of both wings whitish, suffused and clouded with smoky-black; pale towards the base, and gradually darker towards the hind margin, where it is very dark; cilia and margin of costa chequered with black and white; dusky markings indicate the position of the markings on the upper side; cilia broad.

Hind-wings slightly dentate; hind margin crimped; cinereous, with a pinkish gloss; very pale at the base, gradually darker towards the hind margin, which is very dark (especially in the female), except at the termination of the nervures, where it is pale; a central transverse, indistinct, dusky shade, between which and the hind margin is a dusky transverse sinuous line with a large angle in the middle.

Expanse of Wings: male, 1″ 7‴—1″ 8‴; female, 1″ 11‴—2″ 0‴.

Habitat: Wellington, New Zealand.

I have two specimens, presented to me by W. T. L. Travers, Esq., of Wellington, who captured one of them in the theatre, and the other in his garden at Wellington; and one specimen presented to me by Professor Hutton, of Dunedin, and captured I believe at Wellington. Such are the only specimens that have come to my knowledge.

The form of the central and submarginal fasciæ reminds me of the heraldic arms of the Isle of Man, and has suggested the name of *manxifera* for this species.

I have given a drawing (fig. 2′) from a specimen (in my collection) of *C. egregia*, of Felder,* for the purpose of facilitating comparison with *manxifera*.

The genus appears to me doubtful, for although my specimens of *C. egregia* entirely resemble Felder's figure, neither they nor any specimen of *manxifera* clearly agree—particularly as to the palpi and the shape of the tip of the fore-wing—with the genus *Chlenias*, as described in Walker's British Museum List;† nor do they clearly agree—particularly as to the hind-wing—with the family *Ligidæ* (comprising the genus *Chlenias*) as described in that List.

Art. XXIX.—*Note and Description of a possibly new Species of* Aplysia.

By F. H. Meinertzhagen.

[*Read before the Hawke's Bay Philosophical Institute, 17th May*, 1879.]

Animal a dark brown (kelp colour), spotted all over with grey pepper coloured spots. The edges of the lower lobe of the mantle marked evenly with alternate darker brown and grey. The lobe covering the shell striped with grey, all of which stripes point to, and narrow towards, the apex of the shell. Posterior sides of upper tentacles also a peppery grey colour. Shell faintly but finely striated concentrically, horny and flexible at the edges.

Length of shell 1·15 inches, breadth 0·65 inches. Length of animal about 5 inches.

Habitat: Waimarama, Hawke's Bay.

The above animal appears to me to differ in colouring from *A. brunnea*, described by Capt. F. W. Hutton.‡ The shell also appears to me to differ in its measurements from those given by Capt. Hutton, and in appearance from that figured in his plate, being much longer in comparison with its breadth.

* Reise der Nov., Lep. V., Pl. CXXXI., Fig. 24. † Lep. Het., XXIV., p. 1150.

‡ Trans. N.Z. Inst., Vol. VII., p. 279.

The coarse striations and shape of the shell of *A. venosa* leave no doubt that my specimens differ from that animal.

All my specimens discharged the purple fluid (which is characteristic of the genus) on being placed in fresh water, or otherwise annoyed. I noticed also that the lower lobes, which some authors say are used in swimming by this genus, are only used in that way by this species in a very qualified sense. They attach themselves to a rock or to sea-weed by their tail, and allow their body to drift about, simply guiding the direction of their body, and maintaining their upright position, by the movement of the lobes.

As in *Parmophorus*, *Bulla* and *Haliotis* the shells of younger individuals were much larger in relation to their bodies than those of mature age.

The two species, *A. brunnea* and *A. venosa*, are, as far as I am aware, the only species of this family recorded in New Zealand; Capt. Hutton, in his "List of the Marine Mollusca of New Zealand," mentions a single shell from the Bay of Islands. The habitats given for his two species are Wellington and Dunedin.

The occurrence of this Mollusc in this Province is therefore worth recording, even if it should prove to belong to one of those two species. If as I think, it is new, it *requires* to be put on record. I have, however, not had the advantage of seeing specimens of either of the above-mentioned species, so that I cannot definitely state the fact that it is new.

Should it be so, I suggest that it should receive the name *Aplysia tryonii*, as a gentleman of the name of Tryon discovered it here, where I have (I trust not unobservantly in matters connected with conchology) lived for 11 years without having observed it.

Art. XXX.—*On* Anas gracilis, *Buller*.

By Professor Hutton, of the Otago University.

[*Read before the Otago Institute, 14th October*, 1879.]

The Otago Museum has lately received from Paris a specimen of *Querquedula gibberifrons*, Müller, from Celebes, and on comparing it with a specimen of *Anas gracilis*, Buller, from Otago, I find so many points of difference that I am compelled to call in question Dr. Finsch's identification of the two birds.

In *Q. gibberifrons* the breadth of the bill at its base is equal to its height; while in *A. gracilis* it is higher than broad at the base. In *Q. gibberifrons* the wing is shorter, and the middle toe is longer than in *A. gracilis*. There are also the following differences in colour: in *Q. gibberifrons* the

yellow of the lower mandible extends quite to the tip; the general plumage has a redder tinge; there is no white on the neck; and the speculum is not bronzy in any light. The following are the dimensions of the two specimens. *A. gracilis* is a male, shot on the Kaitangata Lake in May, 1877. The sex of *Q. gibberifrons* is not given:—

—	Head.	Bill.			Wing.	Tarsus.	Mid-toe without claw.	Hind-toe without claw.
		Culmen.	Breadth at base.	Height at base.				
Q. gibberifrons ..	2·15	1·45	·6	·6	7·	1·35	1·5	·31
A. gracilis	2·2	1·45	·5	·63	9·	1·25	1·38	·3

It thus appears to me that *A. gracilis* is distinct from *Q. gibberifrons.*

Mr. E. P. Ramsay has compared a specimen of *A. gracilis* with specimens of *A. castanea*, Eyton,* and finds the differences between the two to be very slight. A comparison of the specimens in the Otago Museum shows that the difference in the width of the shield is not constant, it being ·4 in *A. gracilis*, and ·38, and ·45 in two specimens of *A. castanea.* The leg and foot, however, appear to be slightly larger in *A. castanea.* The nail at the end of the bill is also narrower in *A. gracilis* than in either of the others. It is ·19 in *A. gracilis;* ·24 in *Q. gibberifrons;* and ·24, and ·26 respectively, in the two specimens of *A. castanea.* These differences, even if constant, are not of specific value, and merely mark a geographical race; and consequently, in my opinion, *A. gracilis* should be considered a synonym of *A. castanea.*

Art. XXXI.—*Contributions to the Entomology of New Zealand.*

By Prof. F. W. Hutton, of the Otago University.

[*Read before the Otago Institute, 14th October*, 1879.]

In the Ninth Volume of the Transactions of the New Zealand Institute, I described the caterpillars of a few of our butterflies and moths. Since then I have been able—thanks to the kindness of Mr. Butler, of the British Museum—to name more correctly our collection of *Lepidoptera;* consequently I am now able to state correctly the names of some of the insects referred to doubtfully in that paper, and also to add descriptions of a few more caterpillars.

Declava floccosa, Walker (?).

This should be *D. scabra*, Walker.

* Proc. Lin. Soc. N.S. Wales, Vol. III., p, 38.

Declava nigrosparsa, Butler.

Caterpillar.—Smooth; skin crumply, with a row of pectinated tufts on each side. Two pairs of pro-legs, in addition to the claspers; a small tubercle on the penultimate segment, over the last spiracle. A few black hairs on the back. Upper surface variegated with green and brownish purple; under surface green, more or less mottled with white; spiracles yellow, with black margins. Length, 1 inch.

Feeds on *Aristotelia.*

Nitocris comma, Walker.

This should be *N. plusiata.*

Euplexia insignis, Walker (?).

This should be *Xylina ustistriga*, Walker.

Hadena lignifusca, Walker.

This should be *H. debilis*, Butler.

Hadena mutans, Walker.

Caterpillar.—Dull green, more or less tinted with pink. Skin smooth, with a very few short hairs. Below, green. A dark irregular mark through the spiracles. Head, light brown.

The moth came out on October 8th.

Boarmia dejectaria.

Eggs of this species, laid 14th May, 1879, were green.

Hyperythra arenacea, Butler.

Caterpillar.—Light green with a narrow white line on each side, which is shaded with red on the upper side. Length, ¾ inch.

Hyperythra panagrata, Butler.

Caterpillar.—Light green, marbled all over with light pink, which colour forms a decided line over the spiracles; a pair of brown spots on each segment. Spiracles bright orange.

Feeds on *Aristotelia.*

Acidalia schistaria.

Caterpillar.—Dull green with white, more or less black-edged, band down each side. A thin central white line on the back, and a narrow yellow line half-way between it and the lateral white band. Head dull green. Skin smooth.

Hatched 27th November.

Larentia semisignata, Walker.

This should be *Coremia rosearia.*

Larentia corculabia, Guenée (?).

This should be *L. punctilineata*, Walker.

Pseudocoremia lupinata, Felder.

Caterpillar.—Olivaceous brown; the first segment greenish. A few long black hairs. A large dorsal papilla on the eighth segment.

Moth hatched on May 6th.

HELASTIA CHARYBDIS, Butler.

Caterpillar.—Black, smooth, with a more or less interrupted white line down each side. Head brown. Length, ¾ inch.

Moth hatched 17th November.

This species feeds upon *Veronica salicifolia.* The colours are variable, and sometimes it is reddish.

EUPITHECIA INDICATARIA, Walker (?).

This should be *Cidaria muscosata*, Walker.

COREMIA ROBUSTARIA, Walker (?).

This should be *Phibalapteryx rivularis*, Butler.

PHIBALAPTERYX UNDULIFERA, Butler.

Caterpillar.—Brown, with a few scattered brown hairs. A single tubercle on the segment in front of the pro-legs.

Feeds on *Leptospermum ericoides.* The moth comes out in November and December.

CRYPTOLECHIA GALACTINA, Felder.

Chrysalis.—Pale sea-green; white below. Upper surface finely granulated, the granules arranged in rows. Abdomen keeled, with a median row of glandular hairs. Superior surface of the abdomen with black hairs, the inferior with white hairs.

Found on *Myrtus bullata.* The moth came out in March.

CHLENIAS EGREGIA, *Felder. Reise der Novara, Lepidoptera*, Pl. 131, f. 24.

There is a specimen of this moth in the Museum collection. I found it in a box with the other New Zealand moths when I took over the Museum, and consequently I have no reason to doubt the correctness of the locality. Felder gives it from South Australia.

ART. XXXII.—*Contributions to the Cœlenterate Fauna of New Zealand.*

By Professor F. W. HUTTON, of the Otago University.

[*Read before the Otago Institute, 14th October,* 1879.]

SIPHONOPHORA.

Diphyes appendiculata, Eschsch. Acal., p. 138, pl. 17, f. 7; Lesson, Acalèphes, p. 447.

Found occasionally on the coast near Dunedin.

Sarcoconus imbricatus, Quoy and Gaimard, Voy. Astrolabe, Zoologie, IV., p. 71, pl. 3, f. 13 and 15; Lesson, Acalèphes, p. 479.

Physophora australis, Quoy and Gaimard, Voy. Astrolabe, Zoologie, IV., p. 57, pl. 1, f. 19–21; Lesson, Acalèphes, p. 507.

Not uncommon on the coast near Dunedin.

Physalia megalista, Peron et Lesueur, Voy., 2nd ed., pl. 59, f. 1 ; Lesson, Acalèphes, p. 558.

Abundant on the coasts of the North Island, rare near Dunedin.

Velella pacifica, Eschsch. Ac., p. 174, No. 8, pl. 15, f. 4 ; Lesson, Acalèphes, p. 578.

Abundant on the coasts of the North Island. I have never found it near Dunedin.

LUCERNARIDA.

Lucernaria campanulata, Lamouroux. Johnston, British Zoophytes, p. 248.

A specimen collected by Mr. R. Gillies, at Brighton, near Dunedin, answers very well to the description of this species.

ZOANTHARIA.

Diactis, gen. nov.

Column smooth, divided into two portions, of which the upper is retractile into the lower. Tentacles numerous, subulate, arranged in many rows.

This new genus belongs to the family *Antheadæ*. *Actinia nivea*, Lesson (Voy. Coquille, Zoology, chap. xiv., p. 81, pl. III., f. 8), from Peru, probably belongs to it.

D. crocata, sp. nov.

Column: Lower portion longer than broad, expanded at the base, contracted in the middle, pale yellowish brown with numerous white longitudinal streaks; upper portion shorter and narrower than the lower, yellowish orange, very faintly streaked with lighter, and getting brown towards the disc. *Disc* expanded, as broad as the lower portion of the column, circular, concave, yellow-orange. *Tentacles* numerous, half the diameter of the disc in length, and of the same colour. *Mouth* small, elongated, white.

Port Chalmers, a single specimen on *Boltenia australis.*

The body of this animal varies remarkably in form, and is constantly changing its shape. When normally expanded the column is about an inch long. The tentacles are not very sensitive, but can be retracted with the upper part of the column into the lower part.

Peachia carnea, sp. nov.

Column flesh colour; semi-transparent with pale longitudinal lines, contracted below the mouth, and again about one-third from the posterior end, but the form is variable; anus large and conspicuous. *Disc* pale flesh-colour, rayed with brown. *Mouth* raised, surrounded by a brown-banded ring, on one side a number of small papillæ. *Tentacles* twelve, rather longer than the diameter of the disc, simple, pale flesh-colour with about five brown, often chevroned, bands on the upper surface.

Length about 1¾ inch.

A single specimen picked up on the Ocean Beach, Dunedin.

Leiopathes glaberrima, Esper. Pflanzenthiere, II., p. 160, Gorg. pl. 9; Milne-Edwards, Coralliaires I., p. 322.

A large species of *Leiopathes*, closely resembling *L. glaberrima*, is found on the West Coast of the South Island. There is in the Museum a fragment, more than two feet long, from Martin's Bay, but as the cœnenchyma is totally absent, it is impossible to identify it.

Conocyathus zealandia, Duncan, Pro. Zool. Soc., 1876, p. 431.

Flabellum rubrum, Quoy and Gaimard, Voy. Astrolabe, IV., p. 188, pl. 14, f. 5–9; Milne-Edwards, Coralliaires II., p. 96.

Cylicia rubeola, Quoy and Gaimard, l.c., IV., p. 197, pl. 15, f. 12–15; Milne-Edwards, l.c., II., p. 607.

Cylicia smithii, Milne-Edwards, l.c., II., p. 608.

Cylicia huttoni, Tenison-Woods, P.L.S. of New South Wales, III., p. 132, pl. 12, f. 1.

Cylicia vacua, Tenison-Woods, l.c., III., p. 134, pl. 12, f. 4.

Polyphyllia pelvis, Quoy and Gaimard, l.c., IV., p. 185, pl. 20, f. 8–10; Milne-Edwards, l.c., III., p. 26, pl. DII., f. 1.

Cœnopsammia coccinea, Lesson, Milne-Edwards, l.c., III., p. 126.

Cœnopsammia gaimardi, Milne-Edwards, l.c., III., p. 128.

Cœnopsammia urvillei, Milne-Edwards, l.c., III., p. 128.

Alcyonaria.

Capnella imbricata, Quoy and Gaimard, l.c., IV., p. 281, pl. 23, f. 8; Milne-Edwards, l.c., I., p. 124; Gray, A. N. H., 4 Series, III., p. 129.

Lobularia aurantiaca, Lamarck. Quoy and Gaimard, l.c., IV., p. 277, pl. 22, f. 16–18; Milne-Edwards, l.c., I., p. 128.

Primonella australasiæ, Gray, P.Z.S., 1849, p. 146, pl. 2, f. 8–9; Cat. Lithophytes in Brit. Mus., p. 50; Verrill, Bull. U.S. Museum, 1876, No. 3, p. 76.

Anthopodium anstrale, Verrill, Bull. U.S. Mus., 1876, 3, p. 76.

Bluff Harbour; on *Primonella australasiæ*.

Rhipidogorgia cribrum, Valenciennes. Milne-Edwards, l.c., I., p. 175.

Rhipidogorgia arenata, Valenciennes. Milne-Edwards, l.c., I., p. 176.

Ctenophora.

Eschscholthia dimidiata, Lesson, Ann. Sc. Nat., V., p. 254; Acalèphes, p. 102.

ART. XXXIII.—*Additions to the List of New Zealand Worms.*

By Prof. F. W. HUTTON, of the Otago University.

[*Read before the Otago Institute, 14th October*, 1879.]

TURBELLARIA.

Geoplana moseleyi, sp. nov.

SHAPE of the body, as in *G. traversii.* Mouth situated behind the middle; generative orifice half way between it and the posterior extremity. Eyes numerous round the anterior end, forming a line which expands into two patches on each side. Upper surface dark grey, speckled with white, bounded on the sides by a lateral stripe of brown; a broad dorsal stripe, orange, margined with brown, the brown separated from the orange by an interrupted narrow black line; lower surface brownish white.

Dunedin, in the bush, under dead trees.

The body is covered externally with very delicate cilia, which require a ⅛ objective to see.

Genus *Rhynchodemus*, Leidy.

Body much elongated. Eyes two. Mouth cylindrical, elongate. External longitudinal muscles feebly developed. Ovaries simple, near the anterior extremity of the body. Lateral organs distinct.

R. testaceus, sp. nov.

Body elongate, depressed, tapering to an acute point at either end; broadest part behind the centre; upper surface convex, finely transversely striated; lower surface flat, without any ambulacral line. Eyes none. Mouth about two-thirds of the whole length from the anterior end; generative orifice half way between it and the posterior end. Upper surface cherry-red to brick-red; margin and ventral surface yellow. Length sometimes three inches.

Dunedin and Wellington, under stones, or in the ground.

I have not been able to detect either eyes or cilia on this species. I refer it provisionally only to *Rhynchodemus*, in the absence of full information about the genera of land Planarians.

NEMERTIDEA.

Genus *Borlasia*, Oken.

Body long, sub-cylindrical or flattened, obtuse at the extremities; head simple, no eyes; proboscis terminal, with a longitudinal pit on each side; mouth inferior, longitudinal, not terminal; reproductive orifice in a tubercle on the side of the mouth.

B. novæ-zealandiæ, Quoy and Gaimard, Voy. Astrolabe, Zoology, IV., p. 290, pl. 24, f. 15–19.

Length about three inches, flat, pointed posteriorly, the head widened, heart-shaped, united to the body by a short neck, on which there are many

striæ of an intense reddish brown. The mouth is a long slit, very delicate, without any lateral pits. Body reddish brown above, darker on the middle line; below yellow with indications of the intestinal canal, on each side of which there is a vascular system represented by two vessels with lateral ramifications. (Q. and G.)

Bay of Islands.

Gephyrea.

Genus *Phascolosoma*, Müller.

Skin papillose; proboscis with cylindrical tentacles.

P. annulata, sp. nov.

Body papillose, cylindrical, tapering posteriorly; pale brown, the tubercles darker. Proboscis nearly as long as the body, and tapering gradually into it; posteriorly papillose, and coloured like the body; anteriorly smooth, white, with some brown blotches; the anterior end encircled by about twelve narrow, brown, raised rings. Mouth with a ring of short blunt oral tentacles. Length, about 1 inch; breadth, ·2 inches.

Dunedin, and Cape Campbell (Mr. Robson).

Sipunculus lutulentus, sp. nov.

Body cylindrical, narrowed posteriorly and ending in a pyriform swelling; cylindrical portion of the body smooth, faintly reticulated anteriorly, but only transversely striated posteriorly; the posterior pyriform portion rougher, especially the caudal apex. Proboscis short, roughened, thinner than the body. Colour, pale brown. Length, nearly six inches; of proboscis, three-quarters of an inch. Breadth of anterior portion of body, ·4 inch; of proboscis, ·25 inch.

Cape Campbell (Mr. C. H. Robson).

Art. XXXIV.—*Descriptions of new Star-fishes from New Zealand.* By Prof. A. E. Verrill. From the Trans. Connecticut Acad., 1867. Communicated by Prof. Hutton.

[*Read before the Otago Institute, 14th October,* 1879.]

The following interesting species of New Zealand Star-fishes were sent from Peru by Mr. F. H. Bradley, to whom they were given for our Museum by Henry Edwards, Esq. They afford a partial illustration of the little-known *Echinoderm* fauna of the Southern Ocean. They contrast strongly with those of the Northern Hemisphere.

Cœlasterias, Verrill.

Large star-fishes with 4 rows of ambulacral suckers, and large swollen rays (eleven in the tpyical species) which are free to near the base, and are

united beneath by a group of inter-radial plates. Inter-ambulacral plates united directly to the first row of ventral plates, and these to a second row of larger plates without the intervention of open spaces like those seen in *Asterias*. Dorsal surface with large, strong, imbricated, irregularly arranged ossicles or plates, bearing short, very numerous spines.

This species is more closely allied to *Asterias* (*Asteracanthion*) than to *Heliaster*, and approaches still nearer to *Stichaster*, but appears very distinct from either. The excessive development of the abactinial system over the ambulacral is its most remarkable characteristic. In this respect it contrasts strongly with the next genus. The form and general aspect is that of *Solaster*.

CŒLASTERIAS AUSTRALIS, Verrill.

Rays eleven, in the only specimen seen, large, inflated, rounded, tapering rapidly to the end. Disk of moderate size, swollen; radius of disk to length of rays, measuring from the centre, as 2 : 6. The triangular inter-radial space beneath is occupied by a cluster of irregular stout plates, mostly without spines. Ambulacral grooves relatively narrow and shallow, the pores small and crowded, in four well-marked rows. The inter-ambulacral plates usually bear alternately one and two spines, which are long and rather slender towards the mouth, but short, thick, and obtuse towards the end of the ray, and much crowded in indistinct rows. The next row of plates is united directly to these, and the plates are small, longest lengthwise of the ray, and each bears a short, thick, spine but little larger than the preceding, and forming a regular, rather open row. Exterior to these is another ventral row of large, strong, imbricated, prominent plates, each bearing at its summit two very thick, short, obtuse spines, much larger than the inter-ambulacral ones, and arranged in a single row, and on their external side each plate usually supports two or more short, rounded, much smaller spines, the largest of which usually form a regular row. The plates of the first lateral row are much elongated transversely to the ray, imbricated and strong, and so united to the ventral as to leave large openings between; each bears about twelve small, short, rounded, clavate spines, which are placed along the plates in single or double rows transverse to the ray. The plates of the median dorsal row have a similar form, and bear a similar transverse row of spines, which are somewhat larger. Between these and the first row of lateral plates the plates are irregular in form and arrangement, but short and imbricated, with unequal openings between, forming about five indistinct rows, all covered with groups of short subglobular spines, giving an even appearance to the surface, but with large vacant spaces between. Madreporic plate, small, of fine texture, situated a little nearer to the centre of the disk than its edge. Minor pedicellariæ few,

at the bases of the spines and on the spaces between, longer than broad, obtuse, somewhat compressed, constricted near the base. A few major pedicellariæ, scattered on the dorsal surface, and on the inter-radial surface beneath, are much larger and stouter, with enlarged bases and obtuse tips.

Greatest diameter, 11 inches; disk, 4; width of rays at base, 1·25. Auckland, New Zealand.—H. Edwards.

Coscinasterias, Verrill.

Star-fishes with many rays, which are elongated, slender, and united only at the base, without inter-radial plate beneath. Disk small. Ambulacra broad, highly developed, suckers very numerous, in four rows. Spines prominent, arranged in longitudinal rows on the rays. Dorsal surface with large scattered pedicellariæ. Madreporic plate large, irregular, often with several accessory ones placed irregularly on various parts of the disk. Dorsal plates (ossicles) arranged much as in *Asterias*.

The excessive development of the rays and ambulacral system, compared with the disk or central cavity, is the most characteristic feature of this genus. The *Asterias aster*, Gray, probably belongs to this genus, but is too imperfectly described for identification.

Coscinasterias muricata, Verrill.

Rays nine to eleven, slender tapering, rounded above, flat below owing to the width of the ambulacra, narrowed at the base, five to seven times as long as the radius of the disk, which is small. Ambulacral furrows shallow and broad, with very numerous small suckers, crowded in four rows. Inter-ambulacral plates thin, somewhat imbricated, connected with the lateral plates by a row of small, stout ossicles, which alternate with small rounded pores. Each inter-ambulacral plate usually bears a long, slender, tapering spine; these are arranged in a single close row. External to these is a row of distant, longer, and stouter cylindrical spines, arising singly from the connecting ossicles between the inter-ambulacral and ventral plates. The latter are strong and imbricated, each usually bearing two longer and stouter blunt spines, which form a crowded double row, along the sides of the arm. Ossicles of the upper surface very stout, bearing strong, acute spines, which are arranged in about five open rows, the median and two external alone reaching the base of the ray; those of the median row are somewhat larger, and all are surrounded by close wreaths of minute pedicellariæ. On the disk they are smaller and loosely scattered, often obtuse. The major pedicellariæ are numerous, scattered over the whole dorsal surface, and between the ventral spines, and also form a row within the edge of the ambulacral furrow. They vary considerably in size and form upon different parts. Most of those on the dorsal surface are stout, oval, compressed, pointed, nearly twice as long as wide, about ·05 inch long, while with them are

others of similar form not half as large. Those in the ambulacral furrows are even longer, but more acutely pointed. The madreporic plates are variable in number and size as well as in position. One appears to be always in its normal position and near the edge of the disk, while the accessory ones are introduced at various points around the disk, but at about the same distance from the margin. Sometimes, when there are but two and the rays are in even numbers, they are directly opposite and in the same transverse plane. A specimen with eleven rays has two contiguous ones and another separated by four rays, each being composed of several pieces united. One specimen has but one large convex madreporic plate.

The largest specimen is 7·5 inches in diameter across the rays, with a disk 1·25 inch in diameter; rays, ·5 inch broad; inter-ambulacral spines, ·15 inch long.

Auckland, New Zealand.—H. EDWARDS.

ASTERINA (ASTERISEUS) REGULARIS, Verrill.

Pentagonal, depressed, with the inter-radial spaces evenly concave, and the rays short, broad and acute; greatest radius to least as 15 : 10. Ambulacral pores large; inter-ambulacral plates each with two slender acute spines, forming a single row. Those near the mouth larger, obtuse, and flattened. Ventral plates of the first row stout and prominent, each bearing a conical, acute spine, twice as large as the preceding. Exterior to these the ventral or inter-radial plates are flattened or imbricated, diminishing in size as they recede from the centre, each bearing an acute conical spine; these diminish in size like the plates, the larger ones being about as thick as the inter-ambulacral spines, but shorter; near the margin these spines become very small and crowded, many of the plates bearing two. Plates of the upper surface rather large, increasing towards the centre, regularly imbricated, the free margin evenly rounded and thin, bearing near the end a cluster of five to nine very small, nearly equal spines; towards the centre the plates become less regular in form and unequal in size, the larger ones often bearing twelve or fourteen spines in a transverse cluster. Madreporic plate large and prominent, at about one-third of the distance from the centre to the margin. The large dorsal pores are in groups on the sides and within the bases of the rays, arranged in about four rows, which run parallel with the median line of the rays, with from six to twelve pores in a row. A few irregularly arranged pores between adjacent rays connect these groups.

Colour, when dried, dark olive green above, yellow below. From centre to end of ray, 1·5 inches; to edge of disk, ·8.

Auckland, New Zealand.—H. EDWARDS.

ASTROPECTEN EDWARDSII, Verrill.

Rays five, long, regularly tapering, acute, about four-and-a-half times as long as the radius of the disc. Ambulacra broad, inter-ambulacral plates

angular, imbricated, each bearing a cluster of three or four slender spines on the inner edge, and two or three smaller ones on the outer angle, not forming regular rows. Ventral plates densely covered with minute rough spines, each having also a central series of sharp spines, the inner ones very small, increasing outwardly to the external, marginal ones, which are strong, sharp, and slightly curved upward, ¼ inch long. The lower marginal plates are opposite the upper, and project considerably beyond them. The latter are elevated and narrow, twenty-eight on each side of a ray, the two at the angle between the rays much higher and larger, covered like the rest with rough rounded granules, and each surmounted by a stout, blunt tubercle. All the others, except the next two, bear a similar, much smaller tubercle, decreasing regularly in size to the end of the ray. The two next the basal one of each ray are thinner than the rest, and without a tubercle. Paxillæ largest along the centre of the rays, presenting a crowded even surface.

Length of ray from centre 2·6 inches, radius of disc ·6, width of ray at base ·7, of median space ·4.

Auckland, New Zealand.—H. Edwards.

Ophiarachna maculata, Verrill.*

A large yellowish brown species, with stout arms, finely spotted with darker on the upper surface.

Radius of disk to that of arms as 1 : 9 or 10.

Disk large and thick, the inter-radial regions swollen and a smaller lobe bordering each side of the arms at base; upper surface and inter-radial spaces below covered throughout with small, closely crowded, rounded, or slightly polygonal granules; radial shields not visible; at the base of each arm a few naked, imbricated, unequal scales. Mouth-shields broad cordate, broader than long, the inner end obtusely rounded, the sides slightly incurved, the broad outer end emarginate. The accessory plates outside the mouth-shields either two and nearly equal, or three and unequal, in the same specimen; when there are two they form together a narrow, slightly oblong ellipse, much narrower than the mouth-shields; when there are three, the middle one has a broad, rounded triangular form, and the two lateral pieces are small, unequal, and irregular in size and form. Mouth-papillæ seven or eight on each side of the mouth, the inner one elongated, irregularly oval, somewhat pointed; the next much larger than the others, broader than long, somewhat quadrilateral and irregular, the outer edge narrower and flattened; the third a little longer than the first, irregular in form, somewhat pointed at each end; the three or four following are a little smaller, and about equal in size and similar in form, rather oblong, some-

* From the Pro. Boston Soc. of Nat. Hist., Vol. XII., April 7th, 1869, p. 388.

what irregular and wedge-shaped, the outer edge being flattened, those towards the centre a little shorter; these are frequently followed by a small rounded one, which is sometimes wanting; the last one is short and rounded. The narrow space between the mouth-papillæ and mouth-shields is covered with small rounded granules, except about opposite the first, where the side shields are partly exposed. The teeth have been much injured, but there appear to be five, which are stout, broad, the lower ones somewhat squarish, with rounded angles when seen from above, the end flattened, or wedge-shaped, truncate or bevelled. The arms are well rounded, stout at base, regularly tapering to the ends, but not becoming slender. Under arm-plates eight-sided, slightly overlapping, the first eight or ten broader than long, followed by a number that are as long as broad, the length gradually increasing, so that at the twenty-fifth plate the length is decidedly greater than the breadth. Inner tentacle scales oblong, shorter than the arm-plates, toward the disk very broad and stout, truncate, farther out gradually becoming more slender and pointed; outer tentacle scale very short and broad, about half as long as the inner; those at the base of the arms broader than long, the inner side and outer end nearly rectilinear, the articulated edge rounded. Upper arm-plates very broad, and comparatively short, the breadth equal to about five times the length; the outer edge with a slight notch or emargination; many of the plates are irregularly broken into two or three pieces. Two arm-spines on the first plate, three on the second, four on the third, five on the fourth, seven on the fifth, eight on the sixth, nine on the seventh, ten on the eighth, and eleven on the succeeding ones as far as the middle of the arms. These spines are closely crowded, appressed, mostly oblong, with blunt points, about two-thirds as long as the breadth of the side arm-plates; the upper ones smaller and shorter; the lowest one larger and stouter than the rest.

Colour of the disk uniform yellowish brown in the dry specimen. Arms—above—brownish yellow with an orange tinge, thickly covered with small round purplish-brown spots, some of which occur also on the upper arm-spines, and upper part of the side arm-plates. Lower surface, uniform dull yellow.

Radius of disk, ·8 inch; length of arms from centre of disk, 7·25 to 8 inches; breadth of arm at base ·32; height, ·30; length of upper arm-plates, ·08; length of middle arm-spines, ·05; length of third under arm-plate, ·07; breadth, ·09; length of tenth, ·07; breadth, ·08; length of mouth-shield, ·16; breadth, ·21; length of second mouth-papillæ, ·06; breadth, ·08.

New Zealand.—CHAS. CHEEVER, 1848 (Coll. Essex Institute).

Art. XXXV.—*On the Habits of* Prionoplus reticularis, *with Diagnoses of the Larva and Pupa.* By Captain T. Broun.

[*Read before the Auckland Institute, 2nd June*, 1879.]

The subject I propose dealing with will be rendered more intelligible, and perhaps interesting, if I endeavour to convey something like a clear idea of what is meant by the terms employed by naturalists to designate the metamorphoses of insects. This course will seem all the more advisable when it becomes known that I possess specimens of the larvæ and pupæ of other species of Coleoptera, which I hope to describe in subsequent papers.

A beetle originates from a minute, soft, oblong or oval egg instinctively deposited by the parent in such a situation as will ensure a sufficient supply of wholesome food, the mode, time, and place of deposition being liable to considerable variation, and ordinarily succeeded by the death of the female, whose chief purpose in life would thus appear to have been accomplished.

From the egg, in course of time—varying in extent according to species, climate, or other circumstances—emerges the larva, which frequently passes a period of three, or even five years, in solid wood before it attains its full growth and becomes a pupa. It is chiefly during this stage of an insect's existence, according to the mode of life of the members of the group or genus to which it belongs, that it commits so much havoc, or proves of great service to man. The larva—the state analogous to that of the caterpillar of the butterfly or moth, and the maggot of the common fly—is usually a fleshy grub composed of thirteen segments, of which the first forms the head, the next three the thorax, and the remaining nine the abdomen of the perfect beetle; but two or more of these latter ultimately coalesce in such a manner that not more than five or six can be discovered in many Coleoptera. It is provided with six short legs, which are attached to the second, third, and fourth, or thoracic segments. The head is furnished with a pair of rudimentary eyes; two antennæ, commonly called feelers, situated between or near the mouth or eyes; two pairs of transverse or horizontally-moving jaws, of which the upper are termed mandibles and the lower maxillæ, the latter ordinarily armed with feelers, called palpi; a labrum or upper lip; and a labium or lower lip, having a pair of palpi. These organs, conjointly, close the aperture of the mouth when in repose. Respiration is effected, not through the mouth, but by means of a variable number of small, often almost imperceptible orifices referred to in descriptions as spiracles or stigma; these are placed near the sides of the body, and communicate with internal air-tubes.

In due time the larva assumes the form known to us as the pupa, which corresponds with that of the chrysalis of Lepidopterous insects. In this state the beetle is generally soft, and quite harmless—that is, it does not take

any kind of substantial nourishment, and, though inactive, is in reality undergoing important changes. Now, for the first time, may be seen the result of those marvellous transformations which have occurred since the female laid the egg, as the form and structure of the imago, or perfect insect, can clearly be traced.

The beetle issues from the pupa stage during autumn or spring, in the former case generally remaining quiescent during the winter, and, in the vast majority of cases, is short-lived, appearing, indeed, to exist no longer than is necessary for the propagation of the species. It is evident, therefore, that the imago does comparatively little injury, whilst many of the predaceous ground-beetles, which frequently live throughout the spring and summer, destroy vast numbers of insect pests. We are indebted to the microscope and the investigations of many learned naturalists for our knowledge of the anatomy of Coleoptera, the details of which, however, scarcely come within the scope of this paper. Suffice it to say, that the internal organs consist of a stomach, pouch, gizzard and gullet, for the assimilation of food, several "hearts" united by what may be called veins for the circulation of the blood, and the air-tubes previously alluded to under the heading "larva." The anatomical structure can only be advantageously studied in works specially devoted to that branch of the science; the external form, infinite in variety, may, so far as the indigenous Coleoptera are concerned, be studied in the volume now being published by the Colonial Government.* Many people are under the impression that a beetle "grows" considerably; that, however, is a mistake, as the ultimate size of the insect is determined in the larval state, the development depending on the quantity and suitability of the nutriment available.

The foregoing remarks having, I hope, served their purpose, *id est*, enabled those, whose vocations have not permitted them to become entomological students, to realize in their own minds something approaching an accurate conception of the nature of the forms recognized as Coleoptera, I now subjoin descriptions of the larva and pupa of *Prionoplus reticularis*, our largest longicorn beetle.

Larva cream-coloured, sub-cylindrical, attenuated posteriorly, twenty-one lines in length, composed of thirteen very distinct segments, of which the first forms the head; the second is the broadest, measuring 6½ lines across; the next four are the shortest, and about equal in breadth to the second; the others gradually increase in length, and the eleventh is rather broader than the immediately preceding ones. The head is more or less infuscate, the parts of the mouth being pitchy-brown, and is seemingly capable of being retracted within the second segment; it is rounded and densely ciliated in front, the line of demarcation between its anterior and back parts is obvious, the depressed front angles of the latter portion are formed, just behind the lower part of the base of the mandibles, by distinct tubercles; there are four other, but much smaller, elevations

* Coleoptera of New Zealand, by Capt T. Broun.

near the middle of that line, the two anterior distant, the others placed a little further back are only separated by the dorsal groove; behind these there is a curved ridge extending between each antenna and the middle, but not attaining the medial furrow; the space behind is more or less rugose and sparsely hispid, with a few small punctures behind each ridge. The mandibles are large and triangular; the maxillary palpi are robust, four-jointed, abruptly decreasing in bulk, so that the terminal joint becomes quite minute; the labial palpi are tri-articulate, smaller than, but similar in form to the maxillary, but with their apical joint rather less abbreviated; the antennæ are very small, not even as long as the labial palpi, with four joints, of which the last is almost aciculate, and their joints are evidently capable of retraction one within the other. The second segment is larger than the following two united, having near each side a large, slightly-raised, triangular space terminating in a carina, which extends forwards beyond the middle; the disc is rather coarsely rugose, but the sculpture becomes much finer towards the front, where there are some deep wrinkles. On each of the succeeding segments, though less evident on the third and last, there is a large transverse space, slightly elevated, but flattened above, which is distinctly wrinkled; the surface of these segments (3-13) is covered with minute, spine-like elevations, whilst the extremity of the last three is more or less coarsely rugose. The sculpture of the under side of the segments corresponds, more or less, with that of the upper. The spiracles are transversely oval, nine in number on each side, the first, situated on the third segment, is twice as large as any of the others, which are located on the fifth, sixth, seventh, eighth, ninth, tenth, eleventh, and twelfth segments. The legs, attached to the second, third, and fourth segments, are very short, four-jointed, and very similar in structure to the palpi, but having the last articulation more slender and slightly curved.

The larvæ, when immersed in alcohol, become discoloured, so that after the lapse of a few months they become of a pale brown; the size varies, the measurements given above are applicable to full grown examples only.

The *pupa* resembles the larva in colour, is about 21 lines in length by 7 or 8 in breadth in its widest parts, and consists of twelve dorsal segments, the thirteenth being retracted to form the generative organs, whilst the first is represented by the head; it is subject to the modifications observable in the larva when preserved in spirits. The eyes are sometimes discernible, but are covered by a film; the elytra, proceeding from the third segment, are obliquely folded below the body, and, to a great extent, cover the under-wings, which issue from the fourth segment; the antennæ form a curve, and repose on the elytra; the four front legs are folded above these, the posterior pair below the wings.

The second dorsal segment is somewhat similar in outline to the prothorax of the perfect insect, rather uneven, and more or less transversely rugose. The third is about half the length of the contiguous ones, terminates behind in a large, obtuse tubercle, and is also wrinkled. The fourth bears a tubercle near each side, and a median longitudinal row of small tubercular elevations, which, however, become obsolete posteriorly; its surface is a little glossy and exhibits many minute, spine-like tubercles, not, however, so closely congregated as on the remaining segments. The seventh, eighth, ninth, and tenth, bear an obvious discoidal elevation, composed of two almost contiguous tubercles; whilst the last, which might be termed the thirteenth, terminates in two fleshy protuberances.

The information respecting the habits of this insect may be communicated in this way. We will suppose the female to have selected an old

kauri tree, with cracked or damaged bark, or one that has been recently felled, and, by means of her ovipositor, inserted a certain number of eggs which have been duly hatched. On looking at the decumbent log some time afterwards, we simply notice its weather-beaten aspect, but if we examine it more closely we will perceive some small round holes indicating to an experienced eye either the presence or escape of insects. Wishing to ascertain the actual state of affairs we use our axe, or tomahawk, and, owing to the hard external crust, perhaps imagine the log to be quite sound and merely marked superficially, but by dint of a little exertion and perseverance the log is at length cut open, and I venture to assert that the sight which will then meet the eye of the beholder, if not a naturalist, or one accustomed to the ravages of insects, will convince him of the importance of the small animals whose existence, probably, had been altogether ignored. I shall endeavour to describe the condition of such a log, one that I cut open at Parua, near Whangarei harbour. Its external appearance was such as has been indicated, but a little below the surface there were many large cavities about the size of a man's finger, occupied by specimens of the beetle itself more or less mature, all in positions best calculated to facilitate their escape; a little deeper in, I found pupæ and larvæ indiscriminately intermingled in a substance more nearly resembling closely-packed, moist sawdust than anything else, but not at all like the fine timber we would expect to see in a kauri log; on cutting still deeper, or right through, the same scene prevailed, varied only by the absence of the beetle and pupa; here and there might be noticed pieces of what might be termed wood, but with the larvæ assiduously engaged in devouring it; I could almost have kicked the whole to pieces. That log, a settler informed me, had been on the ground some eighteen months, but the eggs must have been deposited, I suspect, about two years previously. Many, no doubt, will exclaim that this is an exceptional case; the sceptic, however, need only do what I have often done, go into the forest and examine a log for himself, and he will return, to use an oft-quoted phrase, "a sadder and a wiser man." It must not be supposed that the ligniperdous proclivities of *Prionoplus reticularis* are confined to the *Dammara australis*, or that its ravages are unmixed evil; I have seen its larvæ at work in *rimu* and *kahikatea* logs, and, in a semi-tropical country, wherein the people, apparently, can afford to allow large quantities of valuable timber to go to ruin, the insect, conjointly with others, devours what would otherwise decay and, during the process, engender serious diseases.

Before leaving this subject, it might not be out of place to direct attention to certain facts showing the wonderful sagacity displayed by the insect. First of all in the deposition of the eggs; then, for the purpose of effectual

concealment, the newly-hatched larva eating its way to the centre of the log; but, when approaching maturity, boring towards the surface again, in order that when it emerges from the pupa state the beetle may readily effect its exit, which, of course, can only be done by eating its way out.

I regret my inability to place before you a portion of the log, as I could not have done so without an assistant to cross-cut a section, and it would then have had to be carried a distance of five miles to my house, and very carefully too, to be of much service in illustrating my remarks. Type specimens of the larva and pupa, in alcohol, accompany this paper, so that they may be preserved in the Museum, where the perfect insect also may be seen.

Art. XXXVI.—*Description of the Larva of* Pericoptus truncatus, *with Observations as to Habitat.* By Captain T. Broun.

[*Read before the Auckland Institute, 2nd June,* 1879.]

The larva of this beetle may be said to be of an elliptically cylindric *form*, being somewhat contracted near the middle, and with its first and anal segments, especially the former, narrower than the adjacent ones. Its upper surface is moderately convex transversely, the lower almost plane, but wrinkled. If preserved in its natural posture, the ventral segments may be seen to be considerably incurved, so that the hinder part of the body appears to be almost at right angles to the anterior. The lateral margins, though uneven, are well defined.

The body is moderately soft, but the head and claws are decidedly corneous.

The *size* varies according to the degree of maturity; my two specimens measure 17 lines in length by 7½ in breadth, and 15 x 6 respectively, but if straightened, the larger must have about 14 lines added to its length.

Its *colour* is uncertain; usually a pale yellow or dirty white, but becoming more or less livid; the head, however, is constantly castaneous, with piceous mandibles, the claws also are pitchy, and the stout bristles borne by the legs and certain portions of the body are of about the same chestnut hue as the head. Sometimes the larva is irregularly spotted with blue, but the colour, as previously indicated, generally degenerates into a brownish white, with livid blotches.

The body is apparently divided into fourteen *segments*, all of which, except the first and three last, are strongly wrinkled transversely, so much so, that some care will be required in determining the difference between the real sutures and the folds; the three terminal are by far the largest; of

these the intermediate is the most bulky, though the apical is actually longer than it, and tapers somewhat towards the extremity. The *head*, including the mandibles, clypeus, and epistome, is more or less irregularly rugose, its sculpture, however, becoming finer towards the base, where there is an obvious longitudinal groove. The second and three terminal segments are almost glabrous, the intervening ones being more or less studded with short spiniform bristles, here and there intermingled with rather long hair-like bristles ; these latter are also distributed over the surface of the other segments, the apex of the last, moreover, bears more and coarser spines than are to be seen elsewhere. The under-surface bears many bristles, but is devoid of spines.

The maxillary *palpi*, including the basal articulation, are four-jointed, the joints are cylindrical, the terminal being the longest and slightly acuminate. The antennæ are more than twice the length of the palpi, formed of four distinct articulations, the socket not being reckoned ; the true second joint is a good deal longer than the others, and, like the first, cylindrical, but obliquely cut away at the end ; the third joint is so placed as to appear slightly forked, and is prolonged beyond the point of insertion of the apical joint, which, therefore, is quite furcate, and has two, more or less evident, indentations at each side. The *clypeus* is transversal, nearly truncate, and densely ciliated anteriorly. The *eye* is quite rudimentary, being represented by a small oval elevation close to the antennal orbit. The *legs* are rather long and robust, bent, coarsely hispid, and four-jointed, with an additional articulation terminating in a large, broad, horny claw : the second joint is short, and, doubtless, merges in the tibia of the perfect insect. The *spiracles* are situated at the sides of the second, fifth, sixth, seventh, eighth, ninth, tenth, eleventh, and twelfth segments.

In my second and smaller example, the under-side is roughly carinated longitudinally, and the terminal joint of one antenna seems as if cleft to its base. On examining the joint carefully, I notice that the inner side of one part is concave, and, consequently, adapted to receive the other. This peculiarity of structure, most likely accidentally exposed to view, indicates the presence of a rudimentary lamellated club, normally concealed by a more or less tough film instead of the usual larval joint.

This *larva* may be met with occasionally in the loose sand of the sea-beach, under logs whose buried portion has become somewhat decomposed ; but whether a certain stage of decay must have been reached before the larva resorts to the log, or the female for the deposition of the egg, I am, as yet, unable to state positively ; this much, however, is certain, that the process of decomposition is greatly accelerated by the larva which gnaws into the wood itself. The masticated wood having passed through its

body, and accumulated around the cavity in the sand or debris usually occupied by the larva, would be apt to lead one to suppose, at first sight, that the wood must have been in a decayed state previous to the insects' recourse to it; experienced observers particularly might be deceived in this matter, knowing, as they do, that the larvæ of the Dynastidæ repair to decomposing vegetable matter as their natural food, their services being peculiarly valuable in rendering such substances innocuous. I apprehend that naturalists have still much to learn respecting the various modes of life of New Zealand insects; preconceived notions derived from the study of the habits of what may be termed "old-world animals," would prove to be unreliable guides in the search for many of our species, which, to my knowledge, pass the various stages of their existence under circumstances quite at variance with cognate, or even congeneric, forms found elsewhere.

I am of opinion that decayed ligneous matter is not at all a necessary means of support to this species; if that were so, the larva would be more often seen; it is nowhere common, certainly not met with in such profusion as to account for the numbers of the imago that may on certain occasions be seen strewn, dead and mutilated, along the sea-shore. Its true home is, beyond doubt, the loose drift above high-water mark.

I have not been able to find the pupa, but I have frequently, especially on calm mornings, followed the tracks of the perfect insects along the beach, whereon they had been disporting during the night, and these invariably ceased amongst the looser drift-sand, into which, it must be evident, the beetles had burrowed, very deeply too, as I could never excavate a hole deep enough to reach them by hand. I was once fortunate enough to secure a living specimen, and, to place the matter beyond mere surmise, allowed him to escape from my hand, when he instantly sought refuge in the sand. At other times I noticed dead beetles belonging to this species which had not effectually secured their retreat, the hind-body being visible.

Another remarkable trait remains to be noticed, that is, the extraordinary paucity of female specimens; of the many hundreds of dead imagos I have seen lying on the beach at various times, I can only remember having found one female!! I do not mean to imply any analogy between the habits of *Pericoptus* and the Bee, beyond the touching fact of her domestic proclivities; if she were not a good wife or daughter, she would surely be more frequently visible to strangers.

I shall deposit an alcoholic specimen as a type of this larva in the Auckland Museum as soon as possible; the perfect insect is already there, and, when compared, they will afford a striking illustration of the metamorphoses of a beetle.

Art. XXXVII.—*Further Notes on New Zealand* Coccidæ.

By W. M. Maskell.

Plate VII.

[*Read before the Philosophical Institute of Canterbury, 5th June,* 1879.]

I have a few new species of Coccidæ to describe; but I must first correct some errors in my former paper.*

I included last year amongst the Coccidæ some insects, to which I gave the names of *Asterochiton* and *Powellia*. Further investigation has shown me that these have to be eliminated. The Order Homoptera is divided into three Classes, distinguished by the number of joints of the tarsus:—1st, the Trimera, including the Aphidæ; 2nd, the Dimera, including Psyllidæ and Aleyrodidæ; and 3rd, the Monomera, or Coccidæ. In some of their stages, the 2nd and 3rd Classes much resemble each other, and my error of last year was caused in a great measure from the fact that the specimens examined presented monomerous tarsi. I have, however, since been fortunate enough to procure a more complete series of these insects, and must now relegate both of them to the Dimerous Homoptera, family Aleyrodidæ. This family is perhaps more anomalous than the Coccidæ, inasmuch as *Aleyrodes* in its earlier stages is scarcely distinguishable from *Lecanium*, but in the adult form widely diverges. In my *Asterochiton*, for instance, only the closest inspection will detect the difference; whilst in *Powellia* the double claw alone (except in the last stage) renders it certainly not a Coccid. However, there is now no doubt, for the adult insects which I have collected have 2-jointed tarsi, double claws, and four broad floury wings,—characters peculiar to Aleyrodidæ. I have no means at present of distinguishing between my *Powellia* or *Asterochiton* and the European species of the family. In the absence of evidence, I leave the names as they are, eliminating the insects from the Coccidæ.

I may remark on the extreme closeness with which the families of the Homoptera run, as it were, one into another. The gradation from *Lecanium* to the earlier stages of *Aleyrodes* is imperceptible; *Aleyrodes* has many features closely resembling *Psylla;* and *Psylla* is linked intimately with *Aphis*. On the young shoots of *Eucalyptus* there is, as I said last year, an insect much resembling in some features my *Powellia*, and this is, I believe, a *Psylla*.

My specimens of *Powellia vitreo-radiata* were from *Discaria* and *Pittosporum*. I have found, on *Olearia ilicifolia*, another species, wanting the long glassy fringe of the earlier stage, and having, instead, a row of lanceolate spines. I would call this species *P. doryphora*.

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* Trans. N.Z. Inst., Vol. XI., Art. XVI.

I have also one or two slight errors to correct as to the Coccidæ. In *Ctenochiton spinosus* the upper digitules are not, as I stated, short; they are long, fine, knobbed hairs. In *Acanthococcus multispinus* and in *Dactylopius glaucus* the lower digitules are broad, as in *Lecanium*.

Further, the insect described by me last year under the name *Diaspis gigas*, is not, as I think now, a *Diaspis*, but belongs to the genus *Fiorinia*, Targioni-Tozzetti, where the pellicle of the second stage almost fills the puparium. I, therefore, as the insect appears to be new, name it *Fiorinia asteliæ*.

Before proceeding to describe the new species which I have obtained, I may mention that *Lecanium hesperidum* seems to be doing less damage—about Christchurch at least—than formerly. Many of the plants and hedges which I have seen nearly destroyed by this insect, are now in much better condition. In Europe and elsewhere the ravages of this insect appear to have been intermittent, and there is no reason why the same should not be the case here. Possibly the dry seasons which we have been suffering under lately may have something to do with this.

Mytilaspis pomorum, on the other hand, is increasing in numbers and destructiveness. I know of scarcely a fruit tree in our orchards (except the cherry) which is not every year being more and more covered with this scale; and the quickset hedges are as much troubled with it as with the saw-fly larva in autumn. Minute as the apple-scale is, its immense numbers must seriously weaken and damage the trees; and I recommend owners of orchards to employ the remedy suggested in my former paper, namely, to paint over their trees in winter with a mixture of two-thirds linseed oil to one-third kerosene. This has, to my knowledge, succeeded admirably in instances where it has been tried, as the oil insinuates itself between the bark of the tree and the puparium of the insect, and so envelopes the eggs and the young that they cannot get out, and so die. Care should, however, I believe, be taken to perform this work only at the dead of winter, when the sap is not rising, and when the tree is, so to speak, asleep.

I proceed now to the description of my new species.

1. *Mytilaspis phymatodidis*, sp. nov.

Plate VII., fig. 1, abdomen.

General appearance resembling *M. pomorum*, but the puparium is broader, as in *M. pyriformis*. The abdomen ends with a deepish median depression, as in *Diaspis rosæ*. There are several scaly processes on the terminal lobes, and a good many spiny hairs on the sides of the body. The usual five groups of spinnerets, and many single ones scattered on corrugations of the body.

I have not seen the male.

My specimens were on a fern, *Phymatodes billardieri*, from Wellington.

2. *Mytilaspis metrosideri*, sp. nov.

Plate VII., fig. 2, abdomen of female.

Puparium white, pyriform. Female in all stages dark-coloured; in last stage nearly black. General outline resembling *M. drimydis*, but the abdomen is much sharper and more pointed, with a finely-serrated edge, ending in three minute-pointed lobes joined by a scaly process. Spinnerets in an almost continuous arch, which may be resolved into five groups; 70 or 80 openings; several single spinnerets. The rudimentary antennæ can be made out.

The young female has an elongated oval outline, little corrugated. The feet, digitules, antennæ, etc., resemble those of *M. pomorum*. The abdomen is like that of the adult, without the groups of spinnerets.

I have not the male of this species.

My specimens are from the *rata* tree.

3. POLIASPIS, gen. nov.

This genus is characterized by having the spinnerets in more than five groups, and in a double row, the edge of the abdomen as in *Diaspis*.

Signoret forms a genus, *Leucaspis*, which possesses the same character; but it has also a fringe of spiny hairs set close together round the edge of the abdomen, which fringe is absent in *Poliaspis*.

Poliaspis media, sp. nov.

Plate VII., figs. 3–5.

The puparium is white, broad. The adult female, which may reach $\frac{1}{24}$ inch in length, resembles in outline *Mytilaspis pomorum*: it is usually greenish-white, and shows the rudimentary antennæ. The abdominal extremity is much jagged, with a median depression as in *Diaspis rosæ*, and with a few scattered hairs. There are eight groups of spinnerets; four, containing each from twenty to thirty orifices, are placed in opposite pairs, the fifth, with four to six orifices, being between the upper pair; above these, three other groups form an arch, the two outer ones having eight to ten openings, the middle one three to five. Many single spinnerets follow the corrugations of the body as in *Mytilaspis cordylinidis*.

The male insect is of a bright scarlet or deep orange colour. The antennæ, covered with longish hairs, have ten joints; the first two very short and thick; the next five long, equal and cylindrical; the eighth and ninth somewhat shorter; the tenth fusiform and as long as the seventh. The legs are rather long; the femur thick, the tibia more slender, broadening towards the tarsus, which is about one-third as long as the tibia, and narrows sharply down to the claws. Both tarsus and tibia are hairy. The

digitules are only long fine hairs ending in minute knobs. The thoracic band occupies about half the width of the body. The abdominal spike is long and, as usual, hairy. There is indeed not much difference in the males of most species of the Diaspidæ. The male of *Poliaspis* is not greatly unlike that of *Aspidiotus epidendri*, or of *Diaspis gigas*.

Poliaspis media, which I have from a *Veronica* and from *Leucopogon fraseri*, is the species alluded to in my former paper,* and which I had not then sufficiently examined.

4. Cœlostoma, gen. nov. (?).

The insects which I have just described belong to the group Diaspidæ; my next belongs to the group Coccidæ, subsection Monophlebidæ.

In my former paper I mentioned, as characteristic of the group Coccidæ, a bi- or tri-articulate mentum, and in the synopsis attached to this paper I give, as a characteristic of the Monophlebidæ, antennæ of eleven joints, a number found in no other subsection of the group. The genus *Cœlostoma* possesses this last character, but it presents the unusual feature of having a mouth formed of only a hollow opening, without any mentum, rostrum, or buccal setæ.

There is a subsection of the group Coccidæ known as "*Porphyrophora*," Brandt (*Porph. polonica* used to be much employed in Europe as a dye), where not only the rostrum and setæ are absent, but there is absolutely in the adult female no trace of a mouth at all! In what manner *Porphyrophora* contrives to extract its nourishment from the plants it lives on I do not know. The *males* of all Coccidæ are destitute of mouths, and it may be presumed that their office is merely to impregnate the females. But how these latter, if mouthless, are enabled to live and grow fat during the period of gestation is not clearly intelligible. But as *Cœlostoma* possesses, at any rate, an œsophagal opening, I must include it amongst the Monophlebidæ; looking on it as perhaps an intermediate genus between *Monophlebus* and *Pophyrophora*.

The characters of this genus are, therefore, antennæ of eleven joints in the adult female, anal tubercles wanting or indistinguishable, an entire absence of mentum, rostrum, or buccal setæ, but retention of an œsophagal opening.

Cœlostoma zealandicum, sp. nov. (?)

Pl. VII., figs. 6–13.

The adult female, figs. 6, 7, is brick-red in colour, reaching ½-inch in length, and rather more than ¼-inch in breadth at the widest part, which is toward the abdominal end. It is fat, corrugated, slug-like: there are eleven or twelve corrugations, those toward the head being the widest. It is sur-

* Trans., Vol. XI., p. 203.

rounded by a thick envelope of white cotton, in which it deposits the eggs, which are oval and brick-red in colour.

The antennæ, fig. 9, spring from the lower side of the head and point downward; they have eleven joints, tapering from the root to the tip. They are all pretty nearly equal in length, but the fifth may be the shortest; the last joint is rounded. All the joints have several longish hairs, those on the last including some longer and thicker than the others.

The anterior pair of feet are placed somewhat forward, near the base of the antennæ, and the next two pairs are not widely separated from them, so that the abdominal region is equal in length to, if not somewhat longer than, the thoracic and cephalic portion. The legs, fig. 8, are black, rather short. The coxa is broad, the femur thick and strong, the tibia more slender, but thickened at the end toward the tarsus. This last is about half as long as the tibia, and tapers to the claw. I saw no digitules, but there is a short stiff bristle at each side of the root of the claw. Each joint of the legs has some hairs; the tibia and tarsus have each, on their inner edge, a fringe of strong hairs. The trochanters are excessively developed and bear a few hairs, of which one is very much longer than the rest.

As I have stated, there is no trace of a rostrum, mentum, or buccal setæ, and the only sign of a mouth which I can detect is a minute orifice situate in a deep depression between the second pair of legs. Indeed, it is not without difficulty that one can discover any sign of a mouth. After maceration in potash and pressure on a glass slide I have noticed a ring surrounding this orifice of somewhat thicker substance than the rest of the skin, and I observed that all round there seemed to be converging masses of muscular tissue; it may be that these, in the act of feeding, are protruded, so as to press the orifice as a sucker on the plant, being withdrawn again at will.

The eyes are very minute, and are so placed in small hollows just behind the base of the antennæ that it is not easy to discover them. They are tubercular, slightly protruding, and appear to show a central orifice. They are not, I believe, facetted.

There are no anal tubercles, as in the Coccidæ proper, and the anus is only an oval opening in the last fold of the body without any ring or long hairs. In the interior of the abdomen, near the anal orifice, is found a small organ which I take to be the oviduct, consisting apparently of a double tube, fig. 10; a ring of recurved spines surrounds the end of each portion, and at the tip are some long hairs. In one specimen also, I have found what I suppose to be the ovary, a long elliptical sac on a stem which extends toward the base of the oviduct, and seemingly full of eggs.

The body generally is flat underneath, rounded above; the corrugations generally smooth, but in some places there appear hard protruding lumps

or callosities as of some exuded substance. The skin, as shown in fig. 10, is covered with minute hairs interspersed irregularly with circular spinnerets. The spiracles appear to be round, as in *Lecanium*; the tracheæ are very large; there are no spiracular spines.

The eggs, as stated above, are brick-red in colour, oval in shape; and I was fortunate enough to hatch out a number of the young insects. These, as shown in fig. 11, have generally the shape of the adult, and are of the same colour. The antennæ, fig. 12, have six joints, of which the last is the largest; on this are several strong hairs. The eyes resemble those of the adult; as also the legs, generally; but these latter, fig. 13, are somewhat longer, and there is no fringe on the internal edge of the tibiæ and tarsus. The trochanter shows the same long hair, but instead of the bristles at the claw there are two long fine knobbed digitules. The rostrum and mentum are prominent and well defined; the latter seems to be bi-articulate; and the setæ are very long and strong (I can only make out three). The skin is covered with circular spinnerets and minute hairs, and the spinnerets are most numerous at the end of the abdomen, where also are two long hairs. The anal orifice seems to be encircled by a folded ring. Length of the young insect, about $\frac{1}{24}$ inch.

In the second stage of its existence the insect does not generally differ from its later form, but the antennæ have only nine instead of eleven joints, and the fringe of strong hairs on the inner edge of the tibia and tarsus is much less developed.

It will be seen that the antennæ follow the same gradation as in the genus *Icerya* (described by me last year), increasing from six to nine, and lastly to eleven joints.

It remains to decide the affinities of this insect. I have put notes of interrogation at the head of this description because I cannot be quite certain that *Cœlostoma* is new. The whole group of the Monophlebidæ requires, I think, more investigation. Most of the species are tropical, or at least, found in out-of-the-way places, and the facilities for examination and description have been by no means great. In one genus of the group, *viz.*, *Monophlebus*, I believe that the females have never been described, and, as I have not the male of *Cœlostoma*, I cannot distinguish it from *Monophlebus*, with this exception,—that I cannot find that *Monophlebus* is destitute of a rostrum. In fact, *Cœlostoma* possesses the characters, as far as I am aware, of most genera of the group. The young insect resembles *Callipappus*; the trochanters of the adult female are like *Porphyrophora*; the callosities of the body resemble *Drosicha*. But it differs from all, and unless it is the female of *Monophlebus*, it must be a new genus; but the frequency of the males of *Monophlebus* elsewhere, and their rarity here,

would seem to eliminate that also. Under the circumstances, especially in view of the curious mouth of the insect, I shall consider it, for the present, as new.

My specimens are partly from Otago, partly from Canterbury. Those from Otago were given to me by Professor Hutton, who informs me that the insect is found there on the bark of large trees. Those from Canterbury I found buried in the ground and in the chinks of rocks, by the Sumner Road, Lyttelton, interspersed with another curious Coccid, feeding on *Muhlenbeckia*, a creeping-plant growing thereabouts. The difference of habitat is, I think, not a little curious.

Since writing the foregoing, I have found some specimens of the male of *Cœlostoma*, which have set at rest any doubts as to its identity. Taken in conjunction with the peculiar mouth of the female, the characters of the male make it impossible to consider the species otherwise than as new. It cannot be *Monophlebus*, as it wants the curiously protruding lobes or tassels attached to the segments of the abdomen; and it agrees with no other genus of the Monophlebidæ.

The male is somewhat large, about $\frac{1}{5}$ inch in length, and nearly $\frac{1}{2}$ inch from tip to tip of the wings when expanded; red or purplish in colour, with a strong red nervure along the anterior edge of the wings, which have also a bluish purple tinge all over. The eyes are large, prominent, and numerously facetted, a character of the Monophlebidæ. The antennæ have ten joints; the two first short and thick, the remainder long and thin, somewhat diminishing to the extremity; each joint with many long hairs, but no distinct nodosities as in *Leachia* (Signoret). The feet are long with a somewhat large trochanter; femur, tibia, and tarsus not thick, the tibia has a dilation at the extremity next the tarsus; both tibia and tarsus have a fringe, on their internal edge, of strong spines (as in the female) also several hairs. Claw long and thin, one pair of digitules which are only long fine hairs; on the trochanter, as in the female, is one hair much longer than the rest. From the term "Monophlebidæ" there should be only one nervure in the wings, but, as M. Signoret remarks, this is a doubtful character; in *Cœlostoma* the nervure appears to me to branch twice at least. The abdomen is corrugated, and on each corrugation are many short fine hairs interspersed with small circular marks; but there is no fringe as in *Callipappus*, Guérin. The sheath of the penis has the form of double oval valves; the penis itself protrudes as in *Callipappus* (and in some *Dactylopii*) as a semi-transparent, soft, white tube several times folded, covered with minute hairs pointing backwards. There is a minute haltere of peculiar shape (like *Porphyrophora*), but, I think, without a seta.

I have no doubt, after examination of the male together with the characters of the female given above, that *Cœlostoma* agrees with none of the

known and described species of the Monophlebidæ, and must be therefore new.

5. Eriococcus, Targioni-Tozzetti.

I described this genus last year, having then one species of it. Since then I have found another, to which I give the name of

Eriococcus hoheriæ, sp. nov.

Plate VII., figs. 14–20.

The sac is, as usual, white and cottony, but for a great part of the year is covered with the black fungus so commonly accompanying Coccidæ, so that it looks only like a small gall or excrescence on the bark. About midsummer, individuals may be found which are completing or have just completed their ovisac, which then shows white in the crevices of the bark. Many such sacs are usually clustered together.

The eggs are very minute, oval, red.

The young insect (fig. 14) is about $\frac{1}{50}$ inch long, red in colour, corrugated, tapering from the cephalic to the abdominal extremity, where it ends in two anal tubercles, each bearing a long seta and some hairs. Antennæ (fig. 15) of six joints, all nearly equal, with a few hairs, mostly on the last joint. Foot (fig. 16) with tarsus a little longer than the tibia; digitules all fine hairs, the upper pair rather long, the lower pair about equalling the claw.

The adult female (fig. 17) is red in colour, about $\frac{1}{30}$ inch in length, generally resembling in shape the young insect, and ending in anal tubercles with setæ. Antenna (fig. 18) of six joints, somewhat shorter than in the young. Foot (fig. 19) apparently atrophied; the tibia is very short, and the femur has a swollen appearance; the digitules are short fine hairs. The anal tubercles (fig. 20) seem at first sight only two; but after maceration in potash are found to be four, of which two bear long setæ. All have spiny hairs, and between them is the anal ring with, I think, eight hairs. Eyes very small, black.

There are some scattered minute hairs on the body, and a number of very small round spinnerets. On the last corrugations, just above the anal tubercles, these spinnerets increase greatly in number and size, and are intermixed with spiny hairs (fig. 20).

This insect, from the bark of *Hoheria*, on the hills above Lyttelton, is, I think, new. The genus *Eriococcus* is not much removed from *Acanthococcus*, Signoret; and the species of both are somewhat confused. Last year I described, under the names of *A. multispinus* and *E. araucariæ*, insects which seemed to me to differ from European species; and so, now, *E. hoheriæ* differs, I believe, from *E. thymi*, Signoret; but it requires some close investigation to distinguish between them; still, the European species has broad digitules, and a small tubercle at the base of the antenna, which I do not find in my specimens from Lyttelton.

I may conclude this paper with a synoptical list of New Zealand Coccidæ as far as I have described them as yet; excluding all those species, chiefly European, which abound in our gardens and greenhouses, with the exception of *Mytilaspis pomorum*, *Lecanium hesperidum*, and one or two other representative species.

ORDER—HOMOPTERA.

CLASS—MONOMERA.

Family—**Coccidæ.**

Group I.—DIASPIDÆ.

Insects enclosed in, or covered by, a test or puparium, composed partly of discarded pellicles of earlier stages, partly of secreted fibres; females, apodous in later stages.

1. *Mytilaspis.*

Puparium elongated; discarded pellicles at one end; not more than 5 groups of spinnerets.

a. *M. pomorum*	European.
b. *M. pyriformis*	New Zealand.
c. *M. cordylinidis*	New Zealand.
d. *M. drimydis*	New Zealand.
c. *M. phymatodidis*	New Zealand.
f *M. metrosideri*	New Zealand.

2. *Poliaspis.*

Puparium elongated; discarded pellicles at end; more than 5 groups of spinnerets.

a. *P. media*	New Zealand.

3. *Aspidiotus.*

Puparium round; discarded pellicles in the centre; not more than 4 groups of spinnerets.

a. *A. epidendri*	European.
b. *A. atherospermæ*	New Zealand.
c. *A. dysoxyli*	New Zealand.
d. *A. aurantii*	N.Z. and Australia.

4. *Diaspis.*

Puparium, round or oval; discarded pellicles at one side; not more than five groups of spinnerets.

a. *D. rosæ*	European.

5. *Fiorinia.*

Puparium, oval or elongated; pellicle of second stage nearly filling the puparium.

a. *Fiorinia asteliæ**	New Zealand.

* Described in Transactions, Vol. XI., p. 201, under the name *Diaspis gigas*.

Group II.—Lecanidæ.

Females retaining feet and antennæ; abdomen cleft at extremity, with two protruding lobes; antennæ generally with seven joints.

Subsection 1.—*Lecanium.*

Females naked; often vivaparous.

a. *L. hesperidum* ... ... European.

Subsection 2.—*Pulvinaria.*

Females naked; forming cocoons for eggs.

a. *P. camellicola* ... ... European.

Subsection 3.—*Lecanio-diaspidæ.*

Females covered by test, waxy or glassy, usually fringed; generally in last stage female shrivelling up at one end of the test.

a. *Ctenochiton perforatus* ... ... New Zealand.
b. *Ctenochiton viridis* ... ... New Zealand.
c. *Ctenochiton spinosus* ... ... New Zealand.
d. *Ctenochiton elongatus* ... ... New Zealand.
e. *Inglisia patella* ... ... New Zealand.

Group III.—Coccidæ.

Females naked, or covered with secretion of cottony fibres or meal; mentum, bi- or tri-articulate; abdomen ending in more or less conspicuous anal tubercles.

Subsection 1.—*Coccidæ.*

Antennæ of not more than eight joints.

a. *Acanthococcus multispinus* ... New Zealand.
b. *Eriococcus araucariæ* ... ... New Zealand.
c. *Eriococcus hoheriæ* ... ... New Zealand.
d. *Dactylopius calceolariæ* ... ... New Zealand.
e. *Dactylopius glaucus* ... ... New Zealand.
f. *Dactylopius poæ* ... ... New Zealand.

Subsection 2.—*Monophlebidæ.*

Antennæ of eleven joints.

a. *Icerya purchasi* ... ... New Zealand.
b. *Cœlostoma zœlandicum* ... ... New Zealand.

To the above I may add the following insects, connected in my papers with the Coccidæ:—

ORDER—HOMOPTERA.

CLASS—DIMERA.

Family—**Aleyrodidæ.**

Aleyrodes.

Four wings, covered with white meal, in both sexes; antennæ with six joints; tarsus two-jointed.

COCCIDÆ.

W. M. Maskell, del. J.B. lith.

a. *Asterochiton lecanioides* ...	...	New Zealand.
b. *Asterochiton aureus* ...	...	New Zealand.
c. *Powellia vitreo-radiata* ...	...	New Zealand.
d. *Powellia doryphora* ...	...	New Zealand.

I have also three species of Hymenopterous insects parasitic on Homoptera, and belonging, as I think, to the genera *Diapria* and *Coccophagus*.

DESCRIPTION OF PLATE VII.

Mytilaspis phymatodidis.

Fig. 1. Abdomen of female, magn. 200 diams.

Mytilaspis metrosideri.

2. Abdomen of female, magn. 200 diams.

Poliaspis media.

3. Abdomen of female, magn. 200 diams.
4. Antenna of male, magn. 100 diams.
5. Foot of male, magn. 100 diams.

Cœlostoma zealandicum.

6. Female, upper-side, magn. 2 diams.
7. Female, under-side, magn. 2 diams.
8. Female, foot, after treatment with potash, magn. 25 diams.
9. Female, antenna, after treatment with potash, magn. 25 diams.
10. Female, ovipositor, magn. 200 diams.
11. Young insect, magn. 25 diams.
12. Antenna of young insect, magn. 60 diams.
13. Leg of young insect, magn. 60 diams.

Eriococcus hoheriæ.

14. Young insect, magn. 60 diams.
15. Antenna of young insect, magn. 200 diams.
16. Foot of young insect, magn. 200 diams.
17. Female, magn. 25 diams.
18. Antenna of female, magn. 200 diams.
19. Foot of female, magn. 200 diams.
20. Anal tubercles of female, magn. 90 diams.

ART. XXXVIII.—*On* Melicerta ringens *and* Plumatella repens

By A. HAMILTON.

[*Read before the Wellington Philosophical Society, 22nd November*, 1879.]

HAVING recently (September, 1879) had occasion to gather a few specimens of *Myriophyllum* from a swamp in the Petane valley, near Napier, I came across several interesting organisms, which I propose bringing under your

notice, not only that another locality may be added to their geographical distribution, but also as objects which will well repay the trouble of collection and study.

The first is a tube-dwelling *Rotifer*, *Melicerta ringens.*

This very curious animal has been well described by Gosse.* He there describes the mode by which the tiny animal forms its tube, by drawing from the water, by means of its cilia, any particles of solid matter which might be held in suspension. These particles, he states, are deposited in the alimentary canal until there is sufficient to form a little ball, the particles of which become cemented together by some secretion of the animal. The ball is then lifted by the head of the animal and deposited in regular sequence on the rim of the tube. Having spent some time in examining a number of these organisms, I found the minute description given by Gosse to be generally correct, with the exception that the formation of the pellets was at a much slower rate than that stated by him. The tubes occur in great profusion on the finely-divided leaves of the *Myriophyllum*, and are easily discernible, some being $\frac{1}{8}$ of an inch in length.

The next specimen is a very puzzling one. Probably it may be referred to *Plumatella repens.* It is a fine species, the polypidon of which adheres at the base, but it eventually becomes less aggregated, and ultimately free; coriaceous, of a dark brown almost black colour, irregularly branched, extending sometimes over 2 or 3 inches; branches composed apparently of tubular cells, with a cup-shaped enlargement and dilated orifices; sometimes in pairs; walls of orifice pellucid. Tentacles yellowish white. Statoblast observable in all.

The ramulus, when adherent, short, when free, elongated.

Statoblast elongated, oval; annulus variable, resembling the eggs of *P. stricta*, Allm., as figured by Van Beneden, or a drawing that I have of *P. fruticosa*, Allm.

The general habit of the Polyp agrees with the description of Allman's *Plumatella repens*, var. β.

I found the above growing plentifully on dead thistles in the swamp, and brought a few specimens home with me and placed them in water. The next morning I found that a number of the individuals had committed suicide by the extrusion of their eggs, which I observed were floating on the surface of the water. Some of the remaining individuals, however, unfolded their tentacles, and enabled me to ascertain that they are not so extremely sensitive to any disturbance as is usually stated in accounts of *P. repens.* Indeed the fact of their growing so freely in such an open situation in only a few inches of water would lead one to infer this.

* Trans. Micros. Soc., Vol. III., (1852) p. 58.

There are many other interesting animals living in this pond, but I must defer noticing them till another opportunity. I would, however, mention that *Lepidurus* (*Apus*) *kirkii* was very plentiful during August and the early part of September, but it has now disappeared, and a large reddish-brown *Hydra* has made its appearance and affords me much amusement in observing its curious method of increase.

Art. XXXIX.—*List of Marine* Mollusca *found in the neighbourhood of Wellington.* By T. W. Kirk, Assistant in the Colonial Museum.

[*Read before the Wellington Philosophical Society*, 21st *February*, 1880.]

In the author's preface to the new Manual of New Zealand Mollusca, just published by the Colonial Museum and Geological Survey Department, the following passage occurs :—"Much still remains to be done towards working out the geographical distribution of the species; and lists would be particularly valuable from Napier, Taranaki, *Wellington*, Nelson, Hokitika, and Banks Peninsula."

Since reading the above-quoted passage, I have carefully examined the large collections contained in the Colonial Museum, and also the private cabinets of Mr. E. Butts, junr., Mr. H. B. Kirk, and Mr. Herbert, to all of whom my sincere thanks are due.

The results of this examination will be found in the following catalogue, which contains in all the names of 262 species and varieties, as follows :—

Cephalopoda—7	Gasteropoda—163
Scaphopoda—2	Lamellibranchiata—84

Brachiopoda—6

This number will probably, ere long, be greatly increased, as no attempt worthy of the name has yet been made to dredge this part of the coast.

Where a species which has no Wellington representative in the Colonial Museum occurs in a private cabinet, the initials of the collector are appended.

For the purposes of this paper, I shall consider the neighbourhood of Wellington to include not only the Harbour, but also that piece of coast between Pencarrow Head and Porirua Harbour.

It was my intention to have appended notes on the relative abundance of the various species, as also on observed phenomena connected with the growth of individual forms; but these must be reserved for a future occasion.

Cephalopoda.

Octopus maorum, *Hutton*.
Argonauta tuberculata, *Shaw*.
Onychoteuthis bartlingii, *Lesueur*.
Ommastrephes sloanii, *Gray*.
Sepioteuthis bilineata, *Q. and G.*
Sepia apama, *Gray* (broken shells).
Spirula peronii, *Lam.*

GASTEROPODA.

Onchidella nigricans, *Q. and G.*
Amphibola avellana, *Chem.*
Siphonaria australis, *Quoy.*
,, sipho, *Sow.*
,, obliquata, *Sow.*
Gadinia nivea, *Hutton.*
Acus kirki, *Hutton.*
Pleurotoma albula, *Hutton.*
Drillia novæ-zealandiæ, *Reeve.*
Daphnella cancellata, *Hutton.*
Defranchia luteo-fasciata, *Reeve.*
Murex zealandicus, *Quoy.*
,, angasi, *Crosse.*
,, octogonus, *Quoy.*
Trophon ambiguus, *H. and J.*
,, stangeri, *Gray.*
,, incisus, *Gould.*
,, inferus, *Hutton.*
,, paivæ, *Crosse.*
Fusus spiralis, *Adams.*
Neptunea zealandica, *Quoy.*
,, caudata, *Q. and G.*
,, dilatata, *Quoy.*
,, nodosa, *Martyn.*
,, ,, var. *B.*
,, ,, ,, *C.*
,, traversi, *Hutton* (small).
Euthria lineata, *Chem.*
,, ,, var. *C.*
,, littorinoides, *Reeve.*
,, martensiana, *Hutton.*
Cominella maculata, *Martyn.*
,, testudinea, *Chem.*
,, nassoides, *Reeve.*
,, lineolata, *Lam.*
,, funerea, *Gould.*
Purpura haustrum, *Martyn.*
Polytropa textiliosa, *Lam.*
,, succincta, *Lam.*
,, striata, *Martyn.*
,, quoyi, *Reeve.*
,, scobina, *Q. and G.*
Ancillaria australis, *Sow.*
Coriocella ophione, *Gray.*
Mitra rubiginosa, *Hutton.*
Voluta pacifica, *Lam.*
,, ,, var.
,, gracilis, *Swainson.* (*E.B.*)
Marginella albescens, *Hutton.*
Erato lactea, *Hutton.*
Triton spengleri, *Chem.*
Ranella leucostoma, *Lam.*
,, vexillum, *Sow.*
Cassis pyrum, *Lam.*
Trivia australis, *Lam.*
,, coccinella, *Lam.*
Struthiolaria papulosa, *Martyn.*
,, ,, *var. B.*
,, ,, ,, *C.*
,, australis, *Gml.*
,, inermis, *Sow.*
Trichotropis inornata, *Hutton.*
Scalaria wellingtonensis, *sp. nov.*
Philippia lutea, *Lam.*
Ianthina communis, *Lam.*
,, iricolor, *Reeves.*
,, exigua, *Lam.*
Natica zealandica, *Quoy.*
Chemnitzia zealandica, *Hutton.*
Obeliscus roseus, *Hutton.*
Odostomia lactea, *Angas.*
Eulima chathamensis, *Hutton.*
Cerithidea bicarinata, *Gray.*
,, nigra, *Q. and G.*
Bittium terebelloides, *v. Martens.*
Littorina cincta, *Quoy.*
,, cærulescens, *Lam.*
Fossarina varius, *Hutton.*
Rissoina plicata, *Hutton.*
,, purpurea, *Hutton.*
Barleeia rosea, *Hutton.*
,, nana, *Hutton.*
,, impolita, *Hutton.*
Turritella rosea, *Quoy.*
,, fulminata, *Hutton.*
Cladopoda zealandica, *Quoy.*
Siliquaria australis, *Quoy.*
Trochita scutum, *Lesson.*
,, novæ-zealandiæ, *Lesson.*
Crypta costata, *Deshayes.*
,, monoxyla, *Lesson.*
,, unguiformis, *Lam.*
Hipponyx australis, *Lam.* (*E.B.*)
Acmæa pileopsis, *Q. and G.*
,, fragilis, *Chem.*
Nerita atrata, *Lam.*
Turbo smaragdus, *Martyn.*
,, ,, *var. B.*
,, granosus, *Martyn.*
Calcar cookii, *Lam.*
,, imperialis, *Lam.*
Rotella zealandica, *H. and J.*
Anthora tuberculata, *Gray.*
,, chathamensis, *Hutton.*
,, tiarata, *Q. and G.*
Euchelus bellus, *Hutton.*

Gasteropoda.—*Continued.*

Diloma æthiops, *Gml.*
,, nigerrima, *Chem.*
,, gaimardi, *Philippi.*
,, hectori, *Hutton.* (*H.B.K.*)
Trochocochlea subrostrata, *Gray.*
Zizyphinus punctulatus, *Martyn.*
,, granatum, *Chem.*
,, selectus, *Chem.*
,, cunninghami, *Gray.*
Cantharidus iris, *Gml.*
,, zealandicus, *Adams.*
,, purpuratus, *Martyn.*
,, huttoni, *Smith.*
Bankivia varians, *Beck.*
Monilea egena, *Gould.*
Gibbula sanguinea, *Gray.*
,, simulata, *Hutton.*
,, inconspicua, *Hutton.*
Margarita fulminata, *Hutton.*
Haliotis iris, *Martyn.*
,, rugoso-plicata, *Chem.*
,, gibba, *Philippi.*
Emarginula striatula, *Quoy.*
Tugali parmophoidea, *Q. and G.*
Parmophorus unguis, *Lin.*
Patella inconspicua, *Gray.*
,, reevei, *Hutton.*
,, affinis, *Reeve.*
,, radians, *Gml.*
,, flava, *Hutton.*
Patella tramoserica, *Martyn.*
,, stellularia, *Quoy.*
,, stellifera, *Chem.*
,, rubiginosa, *Hutton.*
Chiton pellis-serpentis, *Quoy.*
,, sinclairi, *Gray.*
,, concentricus, *Reeve.*
,, glaucus, *Gray.*
Lepidopleurus longicymbus, *De Blainville.*
Tonicia undulata, *Quoy.*
,, rubiginosa, *Hutton.*
Chætopleura nobilis, *Gray.*
Plaxiphora biramosa, *Q. and G.*
Acanthochites zealandicus, *Q. and G.*
,, porphyreticus, *Reeve.*
,, ovatus, *Hutton.*
Cryptoconchus porosus, *Burrow.*
Cylichna striata, *Hutton.*
Bulla quoyi, *Gray.*
Haminea obesa, *Low.*
Philine *sp.*
Aplysia brunnea, *Hutton.*
,, venosa, *Hutton.*
Aplysia tryoni, *Meinertzhagen.*
Pleurobranchæa novæ-zealandiæ, *Cheeseman.*
Doris wellingtonensis, *Abraham.*
Phidiana longicauda, *Quoy.*

Scaphopoda.

Dentalium huttoni, *sp. nov.*
Dentalium *sp.* (broken).

Lamellibranchiata.

Barnea similis, *Gray.*
Pholadidea spathulata, *Sow.*
Teredo antarctica, *Hutton.*
Saxicava australis, *Lam.*
Panopæa zealandica, *Quoy.*
Corbula zealandica, *Quoy.*
Anatina tasmanica, *Reeve.*
Lyonsia vitrea, *Hutton.*
Myodora striata, *Quoy.*
Chamostræa albida, *Lam.*
Mactra discors, *Gray.*
,, scalpellum, *Desh.*
,, æquilateris, *Desh.*
,, donaciformis, *Gray (?)*
Standella ovata, *Gray.*
,, elongata, *Q. and G.*
,, notata, *Hutton.*
Zenatia acinaces, *Q. and G.*
Vanganella taylori, *Gray.*
Raeta perspicua, *Hutton.*
Psammobia stangeri, *Gray.*
,, lineolata, *Gray.*
,, affinis, *Reeve.*
Soletellina nitida, *Gray.*
Tellina alba, *Q. and G.*
,, deltoidalis, *Desh.*
,, disculus, *Desh.*
,, subovata, *Sow.*
Mesodesma novæ-zealandiæ, *Chem.*
,, ovalis, *Desh.*
,, ventricosa, *Gray.*
,, spissa, *Reeve.*
Venus oblonga, *Hanley.*
,, creba, *Hutton.*
Chione lamellata, *Lam.*
,, yatei, *Gray.*

LAMELLIBRANCHIATA.—*Continued.*

Chione costata, *Quoy.*
,, mesodesma, *Quoy.*
,, stuchburyi, *Gray.*
Callista multistriata, *Sow.*
Artemis australis, *Gray.*
,, subrosea, *Gray.*
,, lambata, *Gould.*
,, grayi, *Zittel.* (*H.B.K.*).
Tapes intermedia, *Quoy.*
Venerupis reflexa, *Gray.*
,, paupercula, *Desh.* (?)
Cardium striatulum, *Sow.*
Lucina divaricata, *Lam.*
Diplodonta globularis, *Lam.*
Kellia cycladiformis, *Desh.*
Pythina stowei, *Hutton.*
Solemya parkinsoni, *Smith.*
Crassatella bellula, *Adams.*
Cardita australis, *Lam.*
Barbatia decussata, *Sow.*
,, pusilla, *Sow.*
Pectunculus laticostatus, *Quoy.*
,, striatularis, *Lam.*
Nucula nitidula, *A. Adams.*
,, strangei, *A. Adams.*
,, sulcata, *A. Adams.*
Leda concinna, *A. Adams.*
Solenella australis, *Q. and G.*
Mytilus magellanicus, *Lam.*
,, latus, *Chem.*
,, edulis, *L. Reeve.*
,, ater, *Frauenfeld.*
Crenella impacta, *Hermann.*
Modiola areolata, *Gould.*
,, fluviatilis, *Hutton.*
Lithodomus truncatus, *Gray.* (*H.B.K.*)
Pinna zealandiæ, *Gray.*
Pecten zealandiæ, *Gray.*
,, gemmulatus, *Reeve.*
,, radiatus, *Hutton.*
,, vellicatus, *Hutton.*
Vola laticostatus, *Gray.*
Lima japonica, *A. Adams.*
,, angulata, *Sow.*
Anomia stowei, *Hutton.* (*H.B.K.*)
,, alectus, *Gray.* (*H.B.K.*)
Planunanomia zealandica, *Gray.*
,, ione, *Gray.* (*H.B.K.*)
Ostrea edulis, *L. Reeve.*
,, discoidea, *Gould.*

BRACHIOPODA.

Waldheimia lenticularis, *Desh.*
Terebratella cruenta, *Dillwyn.*
,, rubicunda, *Solander.*
Magas evansii, *Davidson.*
Bouchardia cumingii, *Davidson.*
Rhynchonella nigricans, *Sow.*

ART. XL.—*Descriptions of new Marine Shells.* By T. W. KIRK, Assistant in the Colonial Museum.

[*Read before the Wellington Philosophical Society, 21st February*, 1880.]

Dentalium huttoni.

Shell white, lustrous; small, curved, rapidly tapering, ribbed, ribs unequal, about eighteen at the anterior end, but diminishing in number towards the apex.

Length, ·63 inch; breadth, ·1 at anterior end.

Three specimens from the stomach of a trumpeter (*Latris hecateia*).

Named after Professor Hutton, to whose exertions students of Conchology in this country are so greatly indebted.

Dentalium ecostatum.

Shell white; nearly straight, smooth, gradually tapering; faintly, distantly, transversely striated.

Length, ·6 inch; breadth, ·07 at anterior end.

Waikanae.

Dentalium, sp.

A broken shell, in the collection of Mr. Herbert, Wellington, would appear to add a fifth species of *Dentalium* to our "List;" but as only about half the specimen remains, and that the apical portion, its identification is somewhat difficult.

The shell is white, ribbed, ribs equal, about nineteen in number.

Island Bay, Wellington.

Scalaria wellingtonensis.

Shell white, lustrous; acuminate, imperforate; whorls nine, rounded; varices numerous, thin, about seventeen on the body-whorl; interstices smooth; aperture sub-rotund.

Length, ·4 inch.

Wellington.

Cylichna zealandica.

Shell white; strong, smooth, faintly longitudinally striated. Aperture produced above the spire.

Length, ·35 inch.

Waikanae.

Art. XLI.—*Notice of the Occurrence of* Vitrina milligani *in New Zealand.*

By T. W. Kirk, Assistant in the Colonial Museum.

[*Read before the Wellington Philosophical Society, 21st February*, 1880.]

Up to the present time only two species of *Vitrina* have been recorded as indigenous to New Zealand.* I have now to notice the discovery of a third; a large, highly polished, and really beautiful species.

Vitrina milligani, Pfr.

Shell depressly-ovate, rather solid, polished, very glossy, translucent, olive-black; spire convex; whorls three, second convex, last depressly-rounded; aperture more oblique than diagonal, lunately rounded-oval, within coloured as without; peristome simple; right margin dilated forwards, anterior regularly and columellar slightly arched. (Petterd).

Diameter, greatest, ·9 inch; least, ·6; height, ·4; aperture, ·6 inch long, ·4 broad.—South Karori (T. W. K.)

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* See Manual of New Zealand Mollusca, p. 12.

Art. XLII.—*Additions to the List of New Zealand Fishes.*

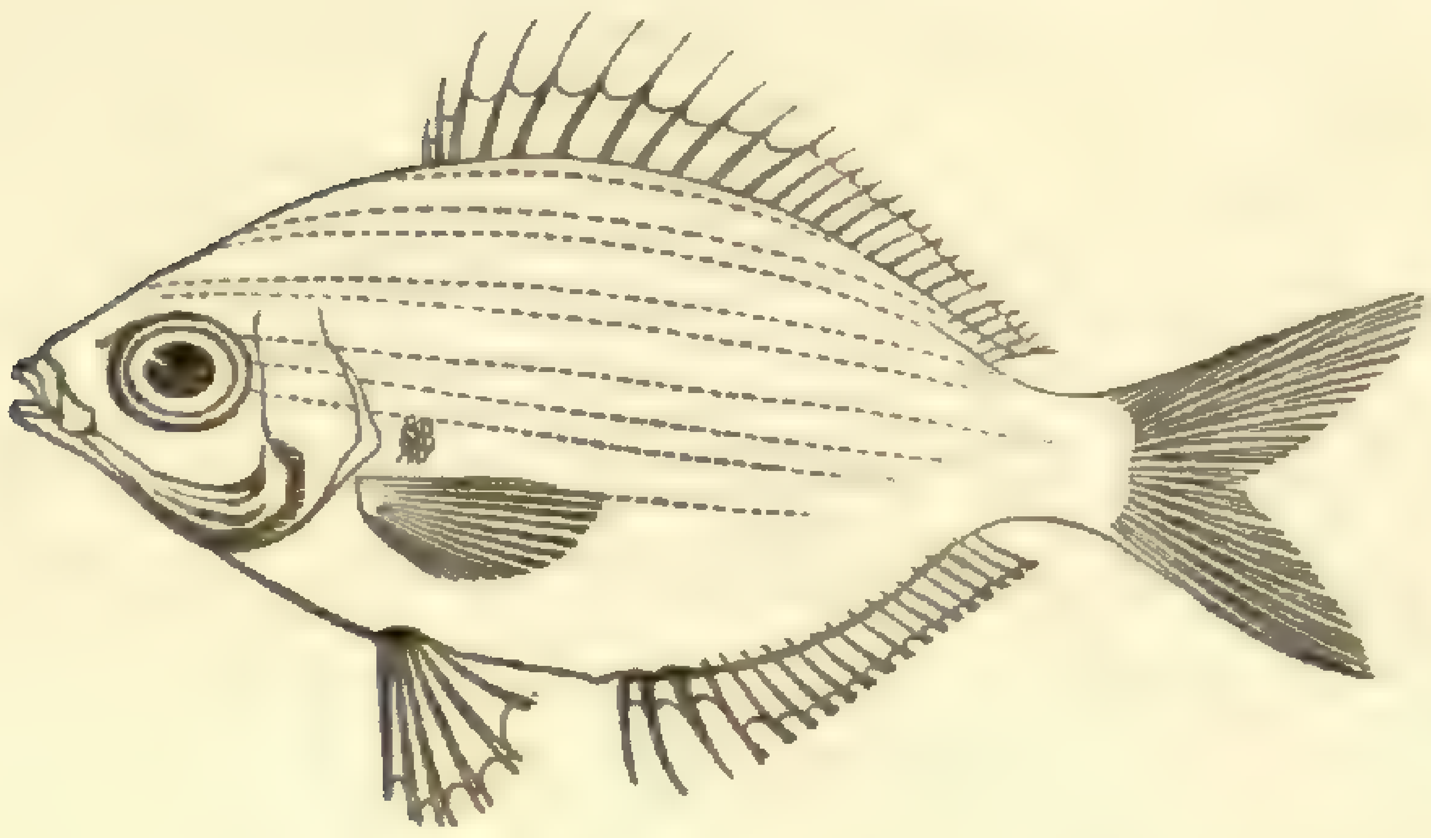
By. T. W. Kirk, Assistant in the Colonial Museum.

[*Read before the Wellington Philosophical Society*, 10*th January*, 1880.]

In October last I received notice that a Turtle had been found at Island Bay, near Wellington, but, on reaching the spot, was greatly disappointed to find that the person who discovered it had not been sufficiently careful to secure his prize, which had consequently been washed away by the next tide; however, I was recompensed by finding specimens of three fish, mentioned below, none of which had previously been obtained on the New Zealand coast, though they are all found in Australia.

Atypus strigatus, Günth.

Günth. II., p. 64.



The genus *Atypus* was created by Dr. Günther specially for the reception of this beautiful little fish, which he mentions very minutely. The following is his description:—

B. 7. D. $\frac{11}{15-16}$. L. lat. 70–75; L. trans. $\frac{11}{26}$.

"The general form of the body is that of a species of *Therapon*; it is compressed, oblong, its greatest height below the fifth dorsal spine being one-third of the total length. The upper profile descends obliquely downwards to the end of the snout, in a very slightly curved line. The length of the head is four-and-a-half in the total length; the extent of the snout is less than the diameter of the eye, or the space between the orbits, which is slightly convex. The cleft of the mouth is small, the upper maxillary reaching to the anterior margin of the orbit. The præoperculum is nearly as wide as high, with the lower margin rounded and very slightly serrated. No pores are visible at or between the pieces of the mandibulæ. The eye is of moderate size. The præoperculum is rather deeply serrated round its margins, the denticulations being longest at the angle, which is a right one. The operculum is not armed. All the head is covered with very small scales. The dorsal fin begins in a vertical drawn from between the bases of the pectoral and ventral fins, and terminates at a distance from the caudal which equals that between the eye and the posterior margin of the operculum. The upper margin of the fin has no notch between the two portions, and its profile descends gradually from the fifth spine to the termination of the fin. The spines are of moderate strength, broader on one

side; the first is the shortest, about half the diameter of the eye; the following increase in length to the fifth, which is tallest, one-half the length of the head; the last is rather longer than one-half the fifth. The anterior rays do not exceed in length the last spine, the whole soft portion is covered with minute scales. The caudal is scaly at the base only, forked, each lobe being 4½ inches in the total length. The anal fin begins in a vertical from the last dorsal spine, and terminates a little behind the dorsal; the three spines are as long as the dorsal ones. * * * The pectorals are scaly at the base, pointed, one-sixth of the total length, and do not reach to the vertical from the vent. The ventrals are inserted behind the pectorals, and reach to the vent; their spine is not quite one-half the length of the head. The teeth of the jaws form a villiform band, with an outer series of stronger ones, which are very slightly flattened. There is a small patch of teeth on the head of the vomer."

Dr. Günther speaking of the specimens in the British Museum, says:—"The ground-colour is *now* greyish-yellow, and appears to have been red in life. The back and sides are banded with brown."

When fresh, the ground-colour of the New Zealand specimen was bright silver, the bands black—not brown, as stated by Dr. Günther; these colours have, however, become much lighter since the fish was placed in spirits.

Another and larger specimen, obtained at Port Jackson, Australia, is in the Colonial Museum; its colours are the same as those of the New Zealand specimen, but not quite so bright, probably from its having been longer preserved.

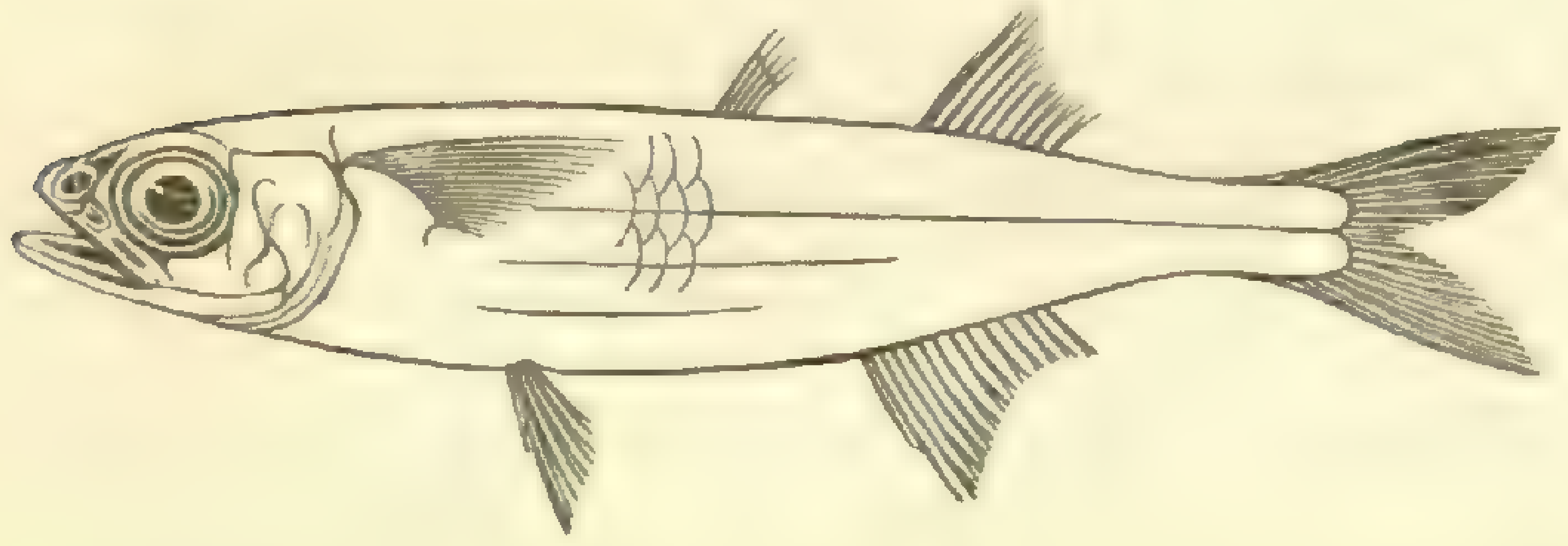
The food of this species appears to be composed almost entirely of *Diatoms*.

Atherina pinguis, Lacep.

Lacep. V., p. 372, pl. 11, fig. 1; Günth. III., p. 399.

D. 5–6 | $\frac{1}{10}$. A. $\frac{1}{14-15}$.

"The origin of the spinous dorsal fin is at some distance behind the vertical from the vent, consequently the dorsal is much nearer to the anal than to the root of the ventral. * * * The height of the body is contained five



times and two-thirds in the total length, the length of the head four times and two-thirds. The diameter of the eye is equal to the width of the interorbital space. Snout obtuse, short, with the cleft of the mouth oblique,

and the upper jaw overlapping the lower. Teeth distinct in the jaws on the vomer and the palatine bones. A silvery streak occupies the third series of scales and the adjoining quarter of the fourth." (Günth.)

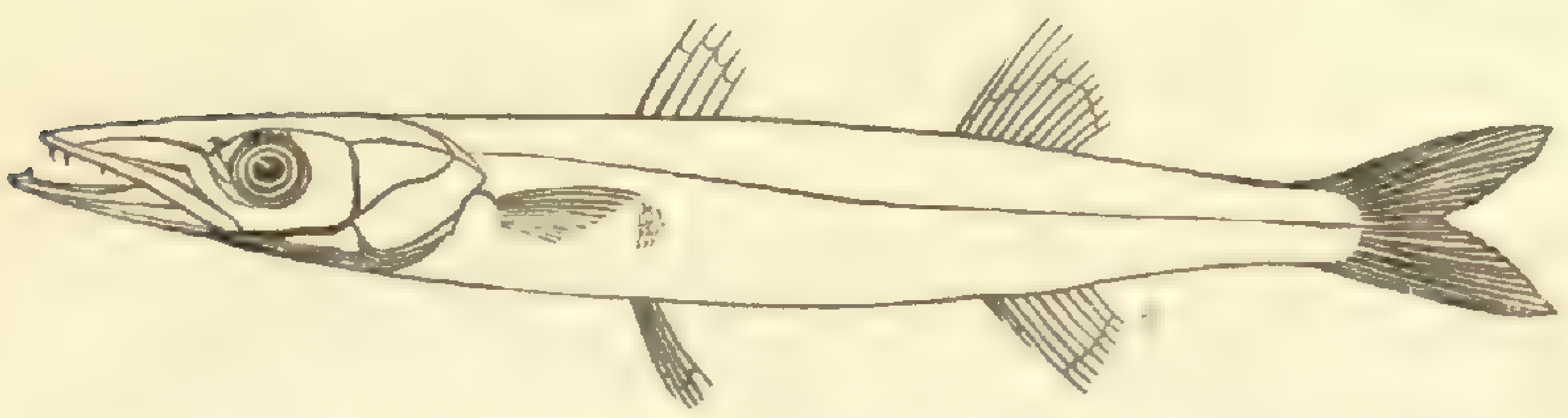
Colour: above dark brown, the extremity of each scale lined with black; under parts and sides below the silver line light brown; fins yellow, tinged with black.

Dr. Günther does not mention the presence of a large triangular scale covering the base of the ventrals.

Sphyræna obtusata.

Sphyræna obtusata, Cuv. and Val. VI., p. 350; Günth. II., p. 339.

"The height of the body is contained seven or eight times in the total length, the length of the head three and a third times; the diameter of the eye is more than one fifth of the length of the head. The first dorsal and the ventral fins commence in the vertical from the extremity of the pectorals. Præoperculum not rounded, with the angle slightly produced." (Günth.)



Colour: above dark brown; sides and under parts silvery; fins yellow.

Odax vittatus, Sol.

The colours of a specimen lately obtained in Wellington Harbour differ considerably from those of the specimen described by Professor Hutton.*

Upper surface dark brown, almost black, marbled with lighter. Lateral streak bright silver, interrupted in places by blotches of salmon colour. Dorsal fin red, with several irregular patches of dark green. Remaining fins green with red rays.

Art. XLIII.—*On the Occurrence of Giant Cuttlefish on the New Zealand Coast.*

By T. W. Kirk, Assistant in the Colonial Museum.

[*Read before the Wellington Philosophical Society, 10th October*, 1879.]

As far as I am aware, there is at present no record of the occurrence of cuttlefish of unusual size on the New Zealand coast. That the Maoris have traditions of the existence of such monsters is, however, beyond doubt. I have therefore great pleasure in laying before the Society all the particulars available relating to several specimens captured on various

* Trans. N.Z. Inst., VIII., p. 215.

parts of our coast, and hope to show that, even in the matter of "devil-fish," New Zealand can hold her own.

1. The first to which I will direct your attention was cast ashore at Waimarama, East Coast. For the following description I am indebted to Mr. F. H. Meinertzhagen, who also very kindly presented me with the beak.

Writing from Waimarama on 27th June last, Mr. Meinertzhagen says:—

"In answer to yours of the 9th, I will furnish you with all particulars of the large cuttlefish found here. I must first tell you that it was obtained in 1870 (September), during my absence in England; the beak was secured for me, which I forward to you by post, and which is quite at your disposal. I enclose also the measurements, made by a friend of mine on whom I could rely, and an extract from his letter written to me at the time, which letter, though quite unscientific, seems to me to give a vivid idea of the dead *Octopus*. 'The beast had eight tentacles, as thick as a man's leg at the roots; horrid suckers on the inside of them, from the size of an ounce bullet to that of a pea at the tip; two horrid goggle eyes; and a powerful beak between the roots of the arms. His head appeared to slip in and out of a sheath. Altogether he was a most repulsive-looking brute. All the natives turned out to see him; and the old men say it is a '*taniwha*'—a '*wheke*' of that size never having been seen by them. They say that a '*taniwha*' of this description attacked and swamped a canoe on its way to Otago; in fact, they do not hesitate to say that this is the identical animal that did the deed! They also say that these large "*whekes*" are very apt to seize a man and tear his inside out. No more sea-bathing for me!' Besides the above extract, I forward a little ink-sketch and measurements made by my friend."

The sketch represents an animal much the same shape as shown in the drawing now before you, but with only eight arms. Length from tip of tail to root of arms, 10 feet 5 inches. Circumference, 6 feet. Length of arms, 5 feet 6 inches.

2. The beak of number 2 was deposited in the Colonial Museum by Mr. A. Hamilton; the animal was captured at Cape Campbell by Mr. C. H. Robson, a member of this society, who very kindly furnished me with the following information. Writing on the 19th June, 1879, he says:—

"In reply to yours of the 12th, about the cuttlefish, I may state that, while stationed at Cape Campbell, I found several specimens of large size, all, however, more or less mutilated, except one, the beak of which I gave to Mr. Hamilton; it was alive, and quite perfect, the body being 7 feet long, eight sessile arms 8 feet long, and two tentacular arms 12 feet. I am, however, only writing from memory. Mr. Hamilton has the exact measurements, and I remember distinctly that the total length was close on 20 feet."

I am sorry to say that Mr. Hamilton has mislaid the notes and measurements, but those given above cannot be far out.

3. On 23rd of May last, the Ven. Archdeacon Stock very kindly sent me word that three boys, named Edward R. Stock, and Frank and Walter Morrah, had that morning discovered, at Lyall Bay, what they took to be a very large cuttlefish, with arms several feet long. I lost no time in proceeding to the spot, determined, if possible, to carry home the entire specimen; but judge my surprise when, on reaching the bay, I saw an animal of the size represented in the drawing now before you.* Victor Hugo's account of his "pieuvre" was brought vividly to my mind, and I could not help thinking that a man would stand but a poor chance if he once got within the grasp of such a monster.

My first step after spreading out the arms, was to make a rough sketch and very careful measurements. I then proceeded to extract the so-called skeleton, but found that some person or persons, who had visited the spot earlier than myself, had not been able to resist the temptation to try the temper of their knives upon its back, and had in consequence severed the cuttle-bone in various places. However, I was able, not only to procure all the pieces, but also the beak, tongue, and some of the suckers, only a few of which remained, the greater portion of them having been torn off, either in some fierce encounter, or during the rough weather which had prevailed for some days previously.

The length of body from tip of tail to anterior margin of the mantle was 9 feet 2 inches and 7 feet 3 inches in circumference; the head from anterior margin of mantle to roots of arms 1 foot 11 inches, making the total length of the body 11 feet 1 inch. The head measured 4 feet in circumference. The sessile arms measured 4 feet 3 inches in length, and 11 inches in circumference; each of these arms bore thirty-six suckers, arranged in two equal rows (as shown by the scars), and measuring from $\frac{13}{16}$ to $\frac{1}{4}$ of an inch in diameter; every sucker was strengthened by a bony ring armed with from forty to sixty sharp incurved teeth. The tentacular arms had been torn off at the length of 6 feet 2 inches, which was probably less than half their original length.

The fins were posterior, and were mere lateral expansions of the mantle, they did not extend over the back as in the case with *Onychoteuthis*, etc.; each measured 24 inches in length and 13 inches in width.

The cuttle bone, when first extracted, measured 6 feet 3 inches in length, and 11 inches in width, but has since shrunk considerably; it was broadly lanceolate, with a hollow conical apex 1½ inch deep.

4. Another specimen, measuring 8 feet in length, was lately caught by a fishing party, near the Boulder Bank, at Nelson, concerning which I have

* The paper was illustrated by drawings showing the animal life-size.

only seen a newspaper cutting, and have not been able to obtain particulars.

5. A fifth was found by Mr. Moore, near Flat Point, East Coast. A description was sent to Mr. Beetham, M.H.R., who, I believe, intends communicating it to this Society.

It will be seen by the above notice that there are at least two species of "Giant Cephalopods" on our coast, as the Waimarama specimen had only eight arms, while those captured at Cape Campbell and Wellington were true Decapods.

I would take this opportunity of recording my thanks to the three young gentlemen who brought news into town of the stranding of the Lyall Bay specimen.

Art. XLIV.—*Description of a new Species of* Palinurus. By T. W. Kirk, Assistant in the Colonial Museum.

Plate XI.

[*Read before the Wellington Philosophical Society, 21st February,* 1880.]

The specimen described in this paper was obtained by Mr. J. Buchanan, F.L.S., in December, 1877, at Whaingaroa, a small harbour on the West Coast of the North Island. It was placed in the Colonial Museum, and until lately bore the label "*Palinurus hugelii* var. *tumidus*," in the handwriting of Dr. Hector, by whom it has since been entrusted to me for description.

In general appearance, this fine species approaches very near *P. hugelii*, from the Indian Ocean, and might at first be mistaken for it; I have, however, carefully compared our specimen with Dr. Heller's description of *P. hugelii*,* and it appears to me to possess characters sufficiently distinct to justify its elevation to the rank of a species.

I therefore propose to retain Dr. Hector's MS. name, and designate the new species "*Palinurus tumidus*," although perhaps, *giganteus*, would be quite as appropriate, the total length from the tip of the beak to the end of the telson being 24 inches, the carapace very much swollen and measuring 21½ inches in circumference.

Dr. Hector informs me that this is the common crawfish at the Sydney market, yet, strange to say, although so large and so common, it does not appear to have been described, the only attempt made to identify it being found in the Sydney Museum, where a specimen bears the label "*Palinurus hugelii ?*."

* See Reise der Osterreichischen Fregatte Novara, Crustaceen, p. 96, tab. VIII.

Palinurus tumidus, sp. nov.

Carapace beaked, much swollen, armed with very blunt spines, or rather spine-knobs, some directed forward, others, again, standing nearly vertical; a double row of small, stout, blunt spines, standing nearly vertical, runs along the posterior edge of the carapace. Beak stout, round, and curved upwards. Supra-orbital spines stout, compressed, turned upwards. Antennæ spines stout, somewhat triangular in shape, and also turned upwards. Superior antennæ less than the total length of the animal, peduncle armed on its upper and outer surface with stout spines. Inferior antennæ smooth, longer than peduncle of superior.

Anterior legs very stout, inferior margin of second joint armed with a row of five or six spines; third joint with a very stout spine at the anterior and also at the posterior extremity, the anterior twice the size of the posterior, also a stout triangular spine on the superior distal extremity; fifth joint with a row of six spines on the superior internal angle, the largest and posterior one being directed backwards to meet the anterior spine of the third joint, a row of three small blunt spines on the inferior internal angle. Superior margin of the distal extremity of the third joint of the last four pairs of legs armed with a spine.

Abdomen very coarsely granulated and punctated. Tail, especially the telson, armed with small spines; telson rounded at the extremity.

Anterior margin of each segment of the abdomen produced into a very prominent spine, backed by three or four teeth.

Whole animal destitute of hair, with the exception of the pedipalps, and the inferior surface of the terminal joint of each pair of legs.

Colour, reddish brown, tinged in many places with yellow.

Length, 24 inches.

Distinguished from *P. hugelii* by its much larger size, by the beak, supra-orbital and antennæ spines being turned upwards, by the telson being less triangular, and rounded instead of scarped.

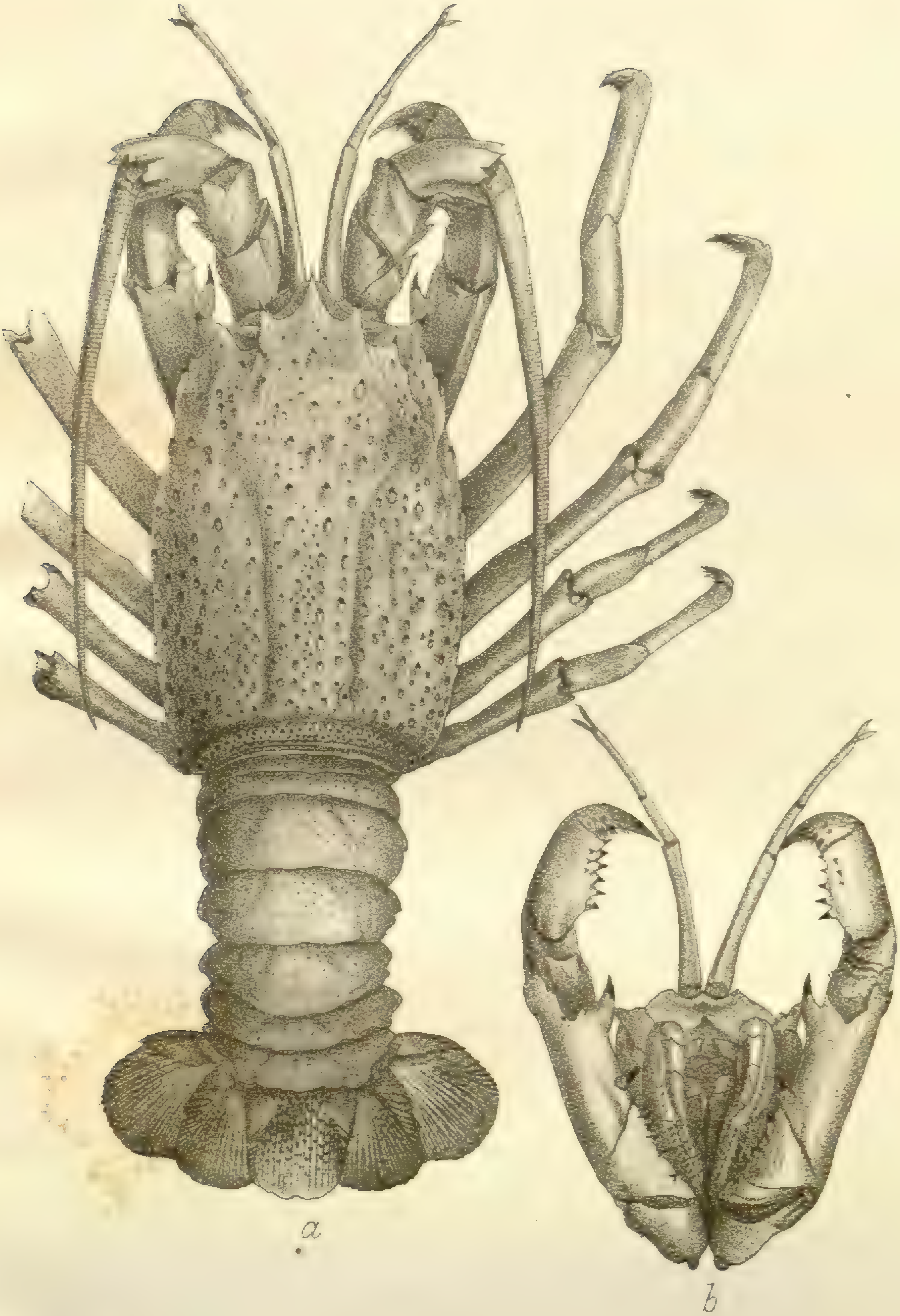
PLATE XI. represents *Palinurus tumidus*. *a*. Dorsal view. *b*. Inferior surface of anterior leg, showing armature.

Art. XLV.—*Description of a new Species of Lizard of the Genus* Naultinus.

By W. L. Buller, C.M.G., Sc.D., F.R.S.

[*Read before the Wellington Philosophical Society, 10th January*, 1880.]

The lizard described in this paper was obtained in August last by Mr. Joseph Annabell while engaged on a Government survey in the wooded country of the Wanganui district. It is an interesting form, belonging to a well known



PALINURUS TUMIDUS sp. nov.

J.B. lith.

group of tree-lizards, whose colours and markings, for protective purposes, bear a strong resemblance to their natural surroundings. The bright green tints of one species enables it almost to defy detection amidst the evergreen foliage of the native shrubs; the marbled-brown skin of another is peculiarly adapted for concealment as it clings to the bark of a tree, or hides in the crevices; whilst a third, which inhabits the sulphur-crusted grounds in the Lake District, is of a uniform bright sulphur-yellow.

The species described by the author of this paper is beautifully marked on its upper surface with patches of pale brown and minute granulations of yellow, exactly resembling in appearance a peculiar *Lichen* common on the bark of certain trees. Apart from good specific characters, it furnishes another remarkable instance of the law of assimilative colouring referred to.

ART. XLVI.—*Notes on Fishes in Upper Whanganui River.*

By Captain MAIR, F.L.S.

[*Read before the Wellington Philosophical Society 10th January*, 1880.]

DURING the summer and autumn rains, large quantities of fish are caught by the Natives in weirs or single lines of stakes driven into the bed of the river at the heads of the rapids, and placed at an angle of about 10 degrees across the current. These lines of stakes are 50 feet or 60 feet long, and 15 yards or 20 yards apart, according to the width of the river. *Hinakis* or wicker baskets are placed at the bottom of each row of stakes, and the fish, which appear always to swim down the middle of the river, upon meeting these lines of stakes placed at a slight angle to the stream, follow them down into the funnel-mouthed *hinakis* aforesaid, and are thus caught. As soon as the pot is full, it is replaced by an empty one. In this manner, I saw about 7 cwt. obtained from two *hinakis*, at Whenuatere, on February 25th, 1879. The fish so obtained are:—*Papanoko*, *Toitoi*, *Inanga*, *Atutahi*, *Upokororo*, and a peculiar kind of eel called *Tunaheke*.

Papanoko are small fish, from six to eight inches in length, and very deep in proportion, as the accompanying rough sketch will show, and weigh about the eighth of a pound. At this season of the year they are very fat, full of spawn, and are most delicious eating. The fins are red; scales very small; back, pepper-and-salt colour; belly, silvery. This fish is called *Te ika huna a Tanemahuta*—the hidden fish of Tane—the god of the forests; for they are never found in the streams or rivers, unless during a flood, and then only during the night. Great ceremony is observed in cooking them, and they are taken some distance from the village for the purpose. The natives aver that if this were not done, no more fish would enter the *hinakis*.

Toitoi are a small blue fish similar to those caught in lakes, but larger. They are fair eating, but rather full of bones—quite unlike the *Papanako*, which have hardly any.

Inanga are plentiful. A large kind, called *Atutahi*, are most esteemed as food; they are almost 5 inches in length, and quite transparent.

Upokororo are plentiful during the first winter months, also lamprey; but the latter are only caught on the lower part of the river.

The eel most prized by the natives is called *Tunaheke*. The name implies that it comes from the sources of the rivers, and goes to the sea. It is a very fine fish, varying from 1–10 lbs. in weight; is bluish-black, with flat head, very small mouth and teeth, tail very wide in proportion to the body; but the most remarkable features are its large, deep, blue eyes. It is very strong and active, and can jump out of a canoe. The natives keep them in large wicker-work baskets, placed in the small streams, for many months, feeding them upon boiled potatoes which keep them in good condition. These fish are supposed to come out of the swamps during heavy floods. It is remarkable that they are never caught except during rains, and do not readily take bait.

Where the Ohura river joins the Whanganui, there is a fall of almost 36 feet. In December and January millions of small eels, from 2–5 inches in length and the thickness of a steel knitting-needle, may be seen crawling up the face of the overhanging rock, whenever there is sufficient moisture. At the time of my visit (February 27th) the season was over; yet we caught a great many, between nine and ten o'clock at night, by brushing them into a net with a whisp of fern It was most interesting to see these little creatures wriggling up the fall in solid masses, apparently hanging on to each other; for if you swept away two or three at the head of the column the remainder all fell back into the water. *Tunariki* are considered a great delicacy by the natives, who hang funnels (shaped like a dunce's cap) made of flax, over the falls, into which these little creatures creep till it is quite full, they are then emptied into baskets. Two or three hundredweight are frequently caught in one night in this manner.

Large *Patiki* (flat fish) are occasionally speared up the river. Formerly they were very plentiful and were caught in nets.

III.—BOTANY.

Art. XLVII.—*On the Botany of the Pirongia Mountain.*

By T. F Cheeseman, F.L.S.

[*Read before the Auckland Institute, 30th June,* 1879.]

Residents and travellers in the Waikato and Waipa districts are all well acquainted with the picturesque Pirongia Mountain. As Hochstetter well remarks :—" This ancient dilapidated volcano" * * * " with its many peaks and ravines" gives to the Waipa country its characteristic scenery. " The eye never tires of gazing at it, as it always assumes new forms from each new point of view."

None of our early naturalists appear to have investigated the flora of the mountain. This is the more singular, as it is easily ascended and is in close proximity to the Waipa river,—before the Maori war, a recognized highway into the interior of the country. Dr. Dieffenbach certainly passed over a portion of the mountain in 1841, but it does not appear that he made any collections on the occasion. Dr. Hochstetter, when journeying up the Waipa Valley, in 1859, turned out of his way to climb the much lower and—in every respect—less interesting hill Kakepuku, but made no attempt to ascend Pirongia. Since then the Maori difficulty practically closed the mountain to Europeans until quite recent times. The following remarks are based upon notes made during two ascents, in January 1877 and January 1879, and must be understood as referring to the eastern and central parts of the mountain only, as on both occasions I failed to penetrate to the western side (partly through want of time and the impracticable nature of the vegetation to be passed through after the first summit is reached; and, on the last ascent, partly through opposition raised by the Maoris. At some future time, I hope to examine the remainder of the mountain, and possibly to give a sketch of its entire flora,—to a knowledge of which the present paper is only a slight contribution.

Pirongia is an extinct trachyte cone, standing on the west side of the Waipa river, almost directly opposite the township of Alexandra. Its highest peaks attain an altitude of 2830 feet, but the range of which it is the culminating point maintains for some distance both to the north and south an average height of over 1000 feet. A continuation of the ridge

running northwards forms the Hakarimata mountains opposite to Ngaruawahia, and at its lowest point, near Whatawhata, is crossed by the road leading from the Waipa to Raglan. The southern range ultimately sinks into the limestone plateau, between the Waipa and Mokau rivers and the western coast. From the mountain itself numerous spurs and ridges radiate in all directions, separated by deep and, in many places, precipitous ravines, These are all occupied by mountain-streams, some of them being of considerable size. Those flowing from the eastern and southern sides of the mountain drain into the Waipa; those rising on the north-western flank form the source of the Waitetuna, discharging into Whaingaroa harbour; while all those which spring from the western and south-western sides flow into some of the many inlets of Kawhia harbour. Standing on the top of the peak overlooking Alexandra, the summit of the mountain is seen to be almost split in twain by an immense chasm, over a thousand feet in depth, probably representing an old crater with its outer edge broken down. A similar, but smaller, chasm exists on the southern face of the mountain, and, if Maori report is to be trusted, also on the western side. The separating ridges are in many places little more than sharp-edged walls of solid rock, rising here and there into domes and peaks, and now and then sinking into comparatively low saddles. A peak on the western side is the highest on the mountain, but several of the other summits almost equal it in height.

The whole of the mountain proper is covered with luxuriant forest; but between its base and the Waipa river there exists a narrow strip of open country, low, fern-clad hills, varied here and there with swampy gullies, and supporting a uniform and somewhat scanty vegetation. *Pteris*, *Leptospermum*, and *Pomaderris* are the most abundant plants. *Coriaria*, *Gaultheria*, *Leucopogon*, *Epilobium*, *Haloragis*, are all commonly met with; in fact, the facies of the vegetation is precisely that of the tertiary clay hills in the immediate vicinity of Auckland. The swamps contain the usual dense growth of *Typha*, *Cladium*, *Schœnus*, and *Carex*. A rather local species of the latter genus (*C. inversa*) was noticed in one or two localities. Among naturalized plants *Hypericum perforatum* was seen in some quantity. It may be remarked, in passing, that this species is spreading rapidly through the Waikato district, and threatens to become a troublesome weed. At Matamata, in the Thames valley, some old pastures have been completely overrun with it.

Entering the forest, the ascent of the mountain is fairly commenced, though for a considerable distance the rise is very gradual. Here our guide pointed out to us the old camping ground—only a few yards distant from the track—where, a few years back, the unfortunate Mr. Todd was murdered by the Maoris while sleeping in his whare. The forest is at first almost

wholly composed of magnificent tawas (*Nesodaphne tawa*). Nowhere have I seen taller or better-grown specimens, and their cool shade was most acceptable after the hot and dusty tramp over the fern-hills from Alexandra. Mixed up with tawas are scattered rimus (*Dacrydium cupressinum*), kahikateas (*Podocarpus dacrydioides*), and ratas (*Metrosideros robusta*). The last-named tree is much more common on the northern side of the mountain, and on the spurs above Harapipi forms a large proportion of the bush. *Dysoxylum*, *Tetranthera*, *Knightia* and *Santalum* are all comparatively plentiful. The undergrowth is principally composed of *Coprosma lucida* and *C. grandifolia*, *Drimys axillaris*, *Alseuosmia macrophylla*, fern trees, and several species of *Gahnia* and *Astelia*. Here and there thickets of the climbing *Freycinetia banksii* are met with, while "supple-jacks" (*Rhipogonum*), and mange-mange (*Lygodium articulatum*), are abundant enough. Nor are the climbing species of *Metrosideros* (*M. florida*, *M. hypericifolia*, *M. scandens*), or the prickly tataramoa (*Rubus australis*) at all rare.

Little change takes place in the vegetation until an altitude of 1200 feet is reached, when the tawa becomes much less plentiful, its place being gradually taken by *Weinmannia racemosa*, *Quintinia serrata*, and *Ixerba brexioides*. *Melicytus lanceolatus* was noticed in one or two localities. Here, the first specimens of a new *Polypodium* (*P. novæ-zealandiæ*, Baker, ms.) were collected.* It is usually found on rotten logs, rarely growing on the ground, and was not seen climbing trees, like its near allies *P. billardieri* and *P. pustulatum*. The rhizome, so conspicuous from its shaggy coating of chestnut-brown scales, is often as thick as the thumb, while fronds were measured (including the stipes) nearly five feet in height, with upwards of twenty pairs of pinnæ. It is abundant over the whole of the higher portion of the mountain.

Above 1500 feet much of the undergrowth is composed of *Coprosma fœtidissima*, well known to bushmen in the south of the Island from its disgustingly fœtid smell when bruised, or even handled. This is the first record of its occurrence to the north of the East Cape. Possibly Pirongia is its northern limit on the west coast, but on the east it has a more extensive range, as it occurs in profusion on the plateau above the Wairere Falls in the Thames Valley, and, according to Maori authority, is also found on Te Aroha. Two other species of *Coprosma* are associated with it on Pirongia; but, in the absence of flowers and fruit, they cannot be safely identified. One is a small, densely branched shrub, 2–5 feet high, with oblong or obovate leaves 1 inch in length, and may perhaps be a large form of *C. colensoi*. The other is a tall, slender shrub, with much of the habit of *C. grandifolia*, but with smaller, narrower, more acuminate leaves, very

* See Trans. N.Z. Inst., X., p. 356.

finely reticulate beneath. This may prove to be *C. acutifolia*, or a close ally. *Panax* is a genus well represented on Pirongia. Besides *P. arboreum* and *P. crassifolium*, which are found all over the mountain, *P. edgerleyi* occurs in abundance on the higher slopes. In foliage it is one of the handsomest of the New Zealand species, and should be much more frequently seen in cultivation than it is at present. *P. sinclairii* is also of frequent occurrence. It had not been previously noticed to the north of Lake Taupo, the habitat of "Auckland," given in the "Handbook," being clearly erroneous. *P. colensoi* is not so common as either of the above, and is seldom seen far from the higher peaks.

Ferns are principally confined to the deep gullies, where they occur in luxuriant profusion. In rocky places, the banks of the streams are fringed for long distances with *Lomaria elongata*. Dark and gloomy places form the favourite habitat for *Lomaria nigra*, while in drier and more open localities *Lomaria vulcanica* is occasionally seen. *Trichomanes strictum* is abundant; while overhanging trees are loaded with the various species of *Hymenophyllum*. On dry rocky banks *Polypodium australe* is more abundant than in any other locality known to me, and attains an unusually large size. It is commonly associated with *Lindsaya trichomanoides*. Our guide informed us that large patches of the para *(Marattia fraxinea)* are to be found in the deeper gullies, and that the Maoris often make expeditions to obtain its starchy rhizome. I did not, however, myself observe the plant. In boggy places, near the summit, extensive clumps of *Todea superba* were noticed: the most northern locality yet recorded for this magnificent species. *Dicksonia lanata* occurs on some of the slopes near the summit, but nowhere shows any sign of producing an erect caudex, in this respect agreeing with specimens found in similar localities on the Cape Colville Peninsula. It may here be mentioned that *Dicksonia antarctica* probably occurs on the lower portion of the mountain, as it is plentiful towards the upper part of the Waitetuna Valley, some of the tributaries of which rise on the north-western flank of Pirongia. Several years ago Mr. W. J. Palmer observed it between Lake Waihi and Ngaruawahia, and quite recently the same gentleman has discovered it in abundance to the west of Lake Whangape, at present the most northerly locality known.

Some distance below the summit, the tawa and rata and others of the lowland trees disappear entirely; *Ixerba brexioides* and *Weinmannia racemosa* now being the predominant species. *Griselinia littoralis* and *Metrosideros lucida* are also plentiful. Rocky places were covered with the creeping *Callixene parviflora*, a charming little plant with waxy white flowers and berries. *Libertia micrantha*, which is found over the greater part of the mountain, is here excessively abundant. A few specimens of *Chiloglottis*

traversii were collected, but all long past flowering. In open mossy places, *Hymenophyllum bivalve* was by no means rare.

The following plants were seen on the highest of the peaks on the Alexandra side of the mountain, altitude about 2,700 feet :—*Rubus australis* var. *cissoides*, *Ixerba brexioides*, *Quintinia serrata*, *Weinmannia sylvicola*, *W. racemosa*, *Fuchsia excorticata*, *Epilobium pubens*, *Panax colensoi*, *P. sinclairii*, *Griselinia littoralis*, *Alseuosmia macrophylla*, *Coprosma lucida*, *C. grandifolia*, *C. sp.*, *C. fœtidissima*, *Gaultheria antipoda*, *Leucopogon fasciculatus*, *Dracophyllum traversii*, *Myrsine salicina*, *Podocarpus totara* (much dwarfed), *Callixene parviflora*, *Libertia micrantha*, *Cordyline banksii*, *Cordyline* "*hookeri*," *Phormium colensoi*, *Astelia trinervia*, *A. sp.* (a small species with very narrow leaves and few-flowered panicles, immature fruit alone seen), *Gahnia hectori*, *Hymenophyllum bivalve*, *H. polyanthos*, *H. demissum*, *Pteris incisa*, *Lomaria procera* var. *minor*, *Lomaria vulcanica*, *Polypodium australe*, *Tmesipteris forsteri*. One of the most interesting of the above is *Cordyline* "*hookeri*," the *toii* of the Maoris, which, on several of the higher peaks, forms small groves of from thirty to forty individuals, usually from 6–10 feet in height. Its broad massive foliage and striking habit of growth render it very ornamental. None of the specimens seen were branched, and no signs of flowers or fruit were observed. Two naturalized plants were collected on the extreme point of the peak, *Hypochæris radicata* and *Rumex obtusifolius*, seeds having in all probability been accidentally brought by the surveyors, who have cleared away the native vegetation in order to obtain an unobstructed view in all directions.

The view at sunrise is a most extensive one. The whole of the western coast, from the Manukau Heads to Raglan, was plainly visible. Kawhia Harbour was shut out by the western side of the mountains ; but the sea again appeared between Albatros Point and Cape Teringa. Beyond this were the Tapirimoko Ranges and the mountains on the further side of the Mokau River. Over the latter the cone of Mount Egmont stood out clear and sharp against the sky, although over 100 miles distant. Looking eastward, the Waikato plain was stretched out at the very foot of the mountain. Behind it, the view was bounded by the Maungatautari mountain and the Patetere plateau. Southwards, looking over the top of Kakepuku, were the Rangitoto Ranges and the broken and mountainous Tuhua country. And, looking over these again, the lofty snow-clad mass of Ruapehu was easily discernible, the upper part of the cone of Tongariro appearing not far from its side. Lake Taupo was hidden by the mountains surrounding it, but portions of the Kaimanawa Range on the eastern or further side of the lake were clearly visible. Northwards, the view extended down the Thames and Piako Valleys, and was finally closed by the Te Aroha Range and the mountains behind Shortland and Grahamstown.

After exploring the three peaks overlooking Alexandra, a start was made to reach the highest peak by proceeding along the crest of the circuitous ridge separating the crater-like chasms before-mentioned; but the vegetation proved so excessively dense and difficult to penetrate, that after spending the greater part of a day in advancing a distance certainly not exceeding a mile, the attempt was abandoned. Trees dwarfed to the height of a few feet occupied the whole breadth of the ridge, their branches spreading horizontally just above the ground. In some places progress could only be made by creeping on all-fours under the vegetation; in others even this course could not be followed, and the only means of advance was by walking on the tops of the trees themselves, the branches being so closely interlaced and matted together as to bear the weight of a man for considerable distances. This mode of progression, although allowing the explorer the benefit of a good view in all directions, is not without its disadvantages, as it is not always possible to feel certain of the exact height above the ground he is travelling at, and, on reaching a weak place, he usually descends to *terra firma* much more suddenly than is at all pleasant or convenient. The dwarfed state of the vegetation is evidently more caused by exposure to the strong winds that periodically sweep over the top of the mountain than to the decreased temperature due to altitude; for in sheltered places only a few yards below the level of the ridge the same species could be seen growing luxuriantly. In very exposed places it was curious to see comparatively large trees growing out horizontally from the edge of the leeward side of the ridge, their branches cut off level with its surface as regularly as if trimmed with a gardener's shears. The character of the vegetation differed in no respect from that of the peak before described, being principally composed of *Ixerba brexioides* and *Weinmannia racemosa.* The excessive abundance of the former species all over the higher portions of the mountain is a most noteworthy peculiarity.

Although the flora of Pirongia is certainly a luxuriant one, and might be considered a favourable example of our forest vegetation, yet it is by no means so numerous in species as that of districts situated more to the north. In short, an examination of it clearly bears out the conclusion arrived at by several observers that the ligneous vegetation of New Zealand steadily decreases in the number of species as we proceed southwards. Anyone acquainted with the vegetation of the Cape Colville peninsula, or of the hilly district behind Whangarei and the Bay of Islands, or of the range of mountains between Mongonui and Hokianga, and comparing either of them with that of Pirongia, would not fail to recognize this. The number of northern species absent is not counterbalanced by the few southern plants added.

In describing the flora of any district it is quite as essential to point out the absence of any species of general distribution which might have been fairly expected to occur, as to record the presence of rare or local ones. It is true that to assert positively that a particular plant is absent from a locality is a somewhat hazardous statement, and one that should never be made unless founded on a careful and minute exploration—which demands time and leisure. At present, too little is known of Pirongia to make any statements of this kind, but it certainly seems desirable to draw attention to a few plants that were not observed by myself, in the hope that future explorers will do something towards ascertaining whether they are really absent from the mountains or not.

Only two species of *Pittosporum* were noticed,—*P. tenuifolium* and *P. cornifolium*; but surely *P. eugenioides* will be found near the base, and *P. kirki* near the summit (the first species being common elsewhere in the Waikato, and the last known to occur in at least one locality). *Elæocarpus hookerianus* and *Pennantia corymbosa* are both trees that would naturally be looked for, but neither was observed. No true myrtle was collected, although *M. bullata*, at least, will doubtless be found. *Corokia buddleoides*, so common in hilly and wooded districts near Auckland, was not seen. Some of the southern *Olearias*, as *O. nitida* and *O. dentata*, might have been expected. No species of *Celmisia* was noticed upon the mountain itself, although *C. longifolia* is found on the bare hills between Harapipi and Whatawhata. *Gaultheria rupestris* should be found on some of the rocky peaks. All the olives were absent, and only one species of *Veronica* and one of *Pimelea* were noticed. I did not observe any of the *Fagi*, but there seems to be no reason why *F. fusca* should not occur. A most remarkable peculiarity is the apparent absence of all the mountain species of *Dacrydium* and of *Phyllocladus trichomanoides*. Among ferns, *Hypolepis distans*, *Lomaria alpina*, and *Aspidium aculeatum*, are species which may be expected to occur on Pirongia, but which were not observed by me.

Before concluding this paper, it seems not out of place to say a few words about Karioi mountain (situated on the coast, between Raglan and Aotea, and about thirty miles distant in a straight line from Pirongia). So far as can be judged from a single day's examination, its vegetation very closely resembles that of Pirongia; in fact, when a few coast plants—as *Vitex*, *Myoporum*, *Olearia albida*, etc.—are excepted, the plants of the two localites are almost identical. All the southern species seen on the summits of Pirongia—as *Coprosma fœtidissima*, *Panax sinclairii* and *P. colensoi*, *Cordyline hookeri*, *Polypodium novæ-zealandiæ*, etc.—re-appeared on the top of Karioi. One marked difference, however, was noticed: *Ixerba brexioides*, which is probably the commonest tree on the higher parts of Pirongia, is decidedly scarce on Karioi.

Art. XLVIII.—*On the Occurrence of the Genus* Sporadanthus *in New Zealand.*

By T. F. Cheeseman, F.L.S.

[*Read before the Auckland Institute, 2nd June,* 1879.]

The plant now constituting the genus *Sporadanthus* was originally discovered by the well-known naturalist, Dr. Ernst Dieffenbach, in the Chatham Islands, in 1840. Neither flowering nor fruiting specimens were obtained, and it was therefore impossible to determine, with accuracy, the systematic position of the plant, although Dr. (now Sir Joseph) Hooker, in the "Flora Novæ-Zealandiæ," ventured to provisionally refer it to the genus *Calorophus*. During the interval which elapsed between the publication of the "Flora" and that of the "Hand-book," no additional information was obtained. Neither does it appear that the plant was observed during Mr. Henry Travers' first visit to the Chathams in 1863–64, for it is not mentioned in the list of species collected by him and recorded in Baron Von Mueller's "Vegetation of the Chatham Islands;" although casually referred to in the introduction as "a doubtful *Calorophus*, mentioned by Dr. Hooker." On Mr. Travers' second visit in 1871, he was more successful, and I believe a good series of specimens was obtained. Some of these, including male flowers, were forwarded to Baron Von Mueller, and from their study he described the plant under the name of *Lepyrodia traversii*.* Shortly afterwards, fruiting specimens were also received, which proved that the plant has nucular and not capsular fruit as in all true species of *Lepyrodia*. This discovery necessitated its removal from that genus; and ultimately Baron Von Mueller proposed a new genus—*Sporadanthus*—for its reception. Under this name it appears in Mr. Buchanan's list of the "Flowering Plants and Ferns of the Chatham Islands."†

Up to the present time, it had been supposed that *Sporadanthus* was entirely confined to the Chatham Islands. In January last, however, while travelling by rail from Hamilton to Ohaupo, in the Waikato District, I noticed that the extensive swamp through which the railway passes before reaching Ohaupo, was in many places entirely covered with a tall-growing Restiad, quite new to me. A few days later, I walked through the swamp for the purpose of identifying the species, and found that it was evidently the Chatham Island plant above referred to. Since then I have learnt from Mr. Percy Smith that it is abundant in some parts of the extensive Piako swamp, and Mr. R. E. M. Campbell also informs me that it occurs in profusion in the centre of the marshy district between Cambridge and Rangiaohia, known as the Moanatuatua swamp. Very probably it will be found in all the larger morasses of the Upper Waikato basin.

* Fragmenta Phytographiæ Australiæ, Vol. VIII., p. 79.

† Trans. N.Z. Inst., Vol. VII., Art. XLVII.

In the Ohaupo locality, *Sporadanthus* is seldom found near the margin of the swamp; but toward the centre, where there is a great depth of peat which affords ample room for its creeping rhizomes and long stringy roots, it occurs in immense abundance, often covering hundreds of acres to the exclusion of almost all other vegetation. Mr. J. Stewart, C.E., informs me that the workmen engaged in constructing the railway dreaded to encounter it, as its thick matted roots not only made it difficult to open out the drains, but were also a sure sign of a bad part in the swamp. In habit it is quite peculiar, and very distinct from any other New Zealand plant. Single clumps, with the stiff, erect stems bare at the base, but branched above, the branches all terminated with brown panicles, and gently drooping outward at the tips, are by no means devoid of elegance; but when seen covering large areas its general appearance is dreary and monotonous.

The discovery of *Sporadanthus* in New Zealand proper, taken in connection with the fact that *Myosotidium* (or the Chatham Island Lily, as it is absurdly called by our gardeners) is known to occur on the Snares, has deprived the Chatham Island Florula of any claim to an endemic genus; and brings into still greater prominence the relationship existing between its vegetation and that of New Zealand; a relationship so close that hardly a dozen species out of the 200 known to inhabit the group are specifically distinct from New Zealand plants.

Art. XLIX.—*A short Sketch of the Flora of the Province of Canterbury, with Catalogue of Species.*—By J. B. Armstrong.

[*Read before the Philosophical Institute of Canterbury, 2nd October,* 1879.]

This short essay is intended as an introduction to the botany of that portion of New Zealand included within the boundaries of the Provincial District of Canterbury.

For the purposes of botanical demonstration, the Province may be conveniently divided into four districts, each differing considerably in its floral features from the others. These are—

1. The Littoral District.
2. The Banks' Peninsula District.
3. The Lowland, or Middle District.
4. The Alpine District.

The Littoral District extends along the coast, and inland about a mile and a half, usually ceasing when the land attains an altitude of twenty or twenty-five feet above the sea level. This district is composed of sand-hills

and maritime swamps. The plants of this district are few, but generally of a totally different character from those found further inland, being especially adapted for growing in sand, and within the influence of the salt breezes of the ocean. Prominent among these sea-side plants are three species of *Convolvulus* identical with those found on the sea-shores of the old country, and which seem to be found in similar localities in almost all countries. We find also several species of *Juncus*, or rush, *Senecio lautus*, *Selliera radicans*, species of *Salicornia*, *Spinifex*, *Samolus*, *Scirpus*, *Euphorbia*, *Mesembryanthemum*, and others, which are equally common in Australia and many other countries. Of species confined to the colony we find *Lepidium oleraceum*, *Festuca littoralis*, *Desmoschœnus*, *Utricularia novæ-zealandiæ*, *Pimelea virgata*, numerous species of sedges, etc.

In the swampy places near the coast we find a number of pretty little herbaceous plants belonging to the following genera:—*Mazus*, *Mimulus*, *Ranunculus*, *Poa*, *Gratiola*, *Utricularia*, *Euphrasia*, and various *Orchidaceæ*. The Canterbury littoral district contains no indigenous trees, but patches of shrubs were common a few years ago, though in many parts of the coast they have almost entirely disappeared. These shrubs belong chiefly to the genera *Coprosma*, *Cassinia*, *Plagianthus*, *Veronica*, and *Leptospermum* or manuka. The native grasses of this district are neither numerous nor of a useful character, and are rapidly dying out under the influences of settlement, though whether their places are being filled by more useful varieties is, I think, extremely doubtful. The littoral district of Canterbury contains about 110 species, comprised in no less than 83 genera. Such a large proportion of genera to the species could not be found in any other similar space outside of New Zealand.

The Banks' Peninsula District.—Banks' Peninsula possesses widely different features in comparison with the district last described. Its boundaries are so well known that I need not attempt to describe them any further than to state that I include the range known as the Port Hills under this name, as they belong botanically to the same region. The peninsula approaches the North Island much more nearly in its floral character than does any other part of the province. The northern slopes of its numerous ranges are generally well grassed, and capable of carrying large numbers of stock in the natural state; though they have unfortunately been much injured by the senseless system of burning which, I am sorry to say, still prevails in this district. The southern slopes, and particularly the gullies, are, or rather were, covered with a most luxuriant vegetation of sub-tropical and Polynesian aspect. Noble trees of most various species entirely covered the ground, and gave shelter and shade to a vast variety of shrubs of great beauty, and nearly one hundred species of ferns luxuriated in the almost

tropical warmth of the deep ravines. Towering stems of tree-ferns, clothed with lovely mosses and *Hymenophyllums*, were to be seen raising their noble heads above the smaller trees and shrubs, whilst numerous lianes belonging to various species of *Clematis*, *Rubus*, *Passiflora*, *Parsonsia*, *Rhipogonum*, and *Muhlenbeckia* hung from one tree to another, connecting these giants of the forest together. Nearly all the trees of the peninsula are evergreen in character, indeed the only deciduous ones I know of are *Plagianthus betulinus* or ribbonwood, and the konini, *Fuchsia excorticata*.

This constant evergreen character of our New Zealand vegetation is by most travellers described as sombre and gloomy, but I think that those who look deeper than the surface will find most beautiful features in many of the trees and shrubs composing this so-called sombre forest.

The forest is composed of a remarkably large number of trees and shrubs belonging to genera of the most varied character and relationship. It is this mixed character which gives the peculiar charm to the New Zealand flora in the eyes of a professional collector. The principal timber-trees of the forest on Banks' Peninsula are:—

1. The totara, *Podocarpus totara*, a fine stout-stemmed tree of the natural order *Coniferæ*, producing a reddish coloured wood, well known to all settlers; and which is now proved to be more durable than any other New Zealand timber, and to stand better in salt water than any other timber yet tried for that purpose.

The totara was formerly abundant over the whole of the peninsula, but is now becoming scarce and more difficult to obtain. It thrives very well under cultivation, but takes a long time to mature its wood and for this reason it will not be much planted.

2. The black pine or matai, *Podocarpus spicata*, another tree of the same family as the last, is still common on many of the spurs in the interior of the peninsula; though a useful tree it is in every way inferior to the totara.

3. The white pine, *Podocarpus dacrydioides*, is not so common on Banks Peninsula as in some parts of the colony. This tree produces a well-known white wood, not durable, but easily worked and excellent when used for inside work. The white pine likes a moist soil, and consequently does not attain any great height on the slopes of the peninsula hills. It is very difficult to cultivate, and is a very slow grower while young, but seems to grow much faster as it gets older.

4. The miro, *Podocarpus ferruginea*, is a much smaller tree than either of those just mentioned, and the wood is generally considered to be of inferior quality, though several instances have come under my observation where this wood has stood for several years in exposed situations without showing

any signs of decay. The miro is easy to cultivate, but is very deficient in beauty in the young state, the whole plant being of a rusty red colour.

5. The rimu or red pine, *Dacrydium cupressinum*, is much less abundant on the peninsula than any of the above sorts, being chiefly found on the higher ridges, and is here a far inferior tree in beauty compared to the West Coast variety of the same species. The well-known red wood of this species makes beautiful furniture, and is also used for interior house-work, for which it is especially adapted when well seasoned. The rimu is a beautiful object under cultivation, but is liable to be killed by exceptionally hard winters. A number of fine young trees in the Christchurch Public Gardens were entirely destroyed by frost during the winter of 1878, and I have also seen it injured in the bush.

6. The cedar, *Libocedrus doniana*, is a very rare tree on the Peninsula, and, as far as I have been able to ascertain, is not found in any other part of the South Island. It is a beautiful tree, of graceful, upright habit, and does well under cultivation. The timber is valuable.

7. The kawaka, *Libocedrus bidwillii*, which in Otago grows to a large size, is here little better than a shrub. Its wood, however, is hard and durable.

8. The broadleaf, *Griselinia littoralis*, is abundant in the district, and produces a hard red wood of a durable nature, which has been used for various purposes.

9. The manuka, *Leptospermum ericoides*, is another hard-wooded tree, which has been used for the different purposes requiring strength, which it possesses in an eminent degree. It is, however, fast becoming extinct.

10. The kowhai, *Sophora tetraptera* var. *grandiflora*, belongs to the great family of pod-bearers, and is a large tree with splendid yellow flowers. It attains a height of 40 feet to 50 feet, and a diameter of 3 feet, and is much used for furniture-making, but is already becoming scarce.

11. The ribbon-wood, *Plagianthus betulinus*, a large deciduous tree with a very upright poplar-like habit of growth, yields a softish white timber which splits well, but is not durable.

The species of *Fagus* or beeches, erroneously called birches by our bushmen, are very rare on the peninsula, occurring only in small quantities, and consequently their timber has never formed an item in the export trade of the district.

The above-mentioned kinds of trees comprise all that are usually cut for their timber, but very many others enter into the composition of the forest and may perhaps be found to have some useful properties at present unknown. Such are:—The hini-hini, *Melicytus ramiflorus*. The titoki, *Alectryon excelsum*. The ivy-tree, *Panax arboreum*. The very curious and beauti-

ful lancewood, *Panax crassifolium.* The tipau or matipo, *Pittosporum tenuifolium*, which makes the best ornamental hedge I know of. The tarata or lemonwood, *Pittosporum eugenioides*, a most beautiful tree also used for hedges. The hohere, *Hoheria angustifolia.* The mako-mako, *Aristotelia racemosa.* The milk-tree, *Epicarpurus microphyllus*, which yields a peculiar milky fluid from the inner bark. The hinau, *Elæocarpus dentatus*, from the bark of which the Maoris obtained a fine dye. The pokako, *Elæocarpus hookerianus.* The ake-ake, *Olearia forsteri*, and the cabbage trees, *Cordyline australis?* and *C. indivisa?* The shrubby plants of the peninsula are exceedingly numerous, belonging to many varied genera; prominent among them are species of *Coprosma, Piper, Drimys, Myrsine, Myoporum, Carpodetus, Olearia, Veronica, Panax, Myrtus*, etc. Several species and genera, which are common in the North Island, are totally absent from Banks' Peninsula, and of course from the rest of the province; such are *Geniostoma, Dysoxylum, Hoheria populnea, Entelea, Atherosperma, Eugenia, Brachyglottis, Knightia, Nesodaphne, Freycinetia*, etc. The large North Island genus *Metrosideros* has no arboreous representative in this district, though *M. lucida* is common much farther south.

Plants which attain their southern limit on the peninsula are the Nikau palm, *Areca sapida*; the karaka, *Corynocarpus lævigata*, which is found in several small bays at the eastern point of the peninsula. Several small and stunted specimens of karaka formerly grew in Dampier's Bay, Lyttelton. *Senecio saxifragoides* finds its southern limit here, and probably also *Alectryon excelsum* and *Libocedrus doniana.* I have not been able to ascertain that any species finds its northern limit on Banks' Peninsula, but the following plants appear to be confined to the district—*Celmisia makaui* and *Pittosporum obcordatum.*

Banks' Peninsula contains 350 species of flowering plants belonging to 171 genera.

The Lowland or Middle District.—Under this name I include the great Canterbury plain, together with the groups of downs at each end of the province, and so much of the eastern face of the great Alpine range as lies below 2000 feet. A reference to the map will show that the district, as here defined, is a very extensive one, being about 150 miles long by 30 to 50 miles wide.

The great Canterbury plain is remarkably poor in plants, and is very uniform in character. Grasses form here the principal part of the vegetation, except in the numerous swampy places along the sea-coast, which before the settlement of Europeans were covered with a dense growth of *Phormium tenax, Astelia grandis*, and numerous species of *Cyperaceæ*, and *Junceæ.*

The most abundant grasses are the tussock-grass, *Poa cæspitosa*, etc., an undescribed species of fescue usually referred to *Festuca duriuscula*, Linn., by most New Zealand collectors. The hassock-grass, *Aira cæspitosa*, *Agrostis æmula*; the holy-grass, *Hierochloe redolens*; the plume-grass, *Dichelachne crinita*; and the blue-grass, *Triticum squarrosum*. Among these grasses grew a few pretty little herbaceous plants belonging to the genera *Raoulia*, *Craspedia*, *Cotula wahlenbergia*, *Pelargonium*, *Geranium*, and *Geum*, and in wet places many interesting little plants, such as species of *Pratia*, *Ranunculus*, *Lomaria*, *Triglochin*, *Micromeria*, and others. The vegetation of the downs does not differ materially from that of the plain, but in many of the valleys at the base of the main chain, small patches of forest are found, and have been of great value to the settlers. These small forests, or bushes as they are commonly called, consist of totara, miro, rimu, matai, and the two common species of birches—*Fagus cliffortioides* and *F. solandri*.

When these bushes are at a low elevation, as at Waimate and Geraldine, the *Coniferæ* prevail; but whenever the elevation much exceeds 600 feet, the *Fagus* become the principal tree; though the *Coniferous* species do not altogether cease until we reach a height of 2,000 feet. The smaller trees mentioned as common on the peninsula are here comparatively rare and often altogether absent. Shrubby plants are much less numerous in this district than in any other part of the colony.

A few patches of shrubs were occasionally to be found on the plains, and were formed of *Discaria toumatou*, *Coprosma parviflora*, *Leptospermum scoparium*, *Olearia virgata*, and *Cassinia vauvilliersii*. The common cabbage-tree of the South Island, a species of *Cordyline* doubtfully referred to *C. australis*, of Hooker, was formerly rather common, and helped to enliven what was at best a dreary scene.

The lowland district contains about 360 species arranged under 160 genera of flowering plants.

The Alpine District.—This is by far the most interesting of these divisions, as it contains a very large number of most beautiful shrubs and herbaceous plants which are likely at no distant date to become the common ornaments of European gardens, for which they are eminently fitted, from their great hardiness, easy propagation, and exquisite beauty. Indeed, a demand for our native Alpine plants has already sprung up in England, and several of them are to be found in the lists of the leading London nurserymen.

The Alpine district may be further divided into the following zones of vegetation, which are generally clearly defined, except in the valleys of the rivers, where the plants of the upper zone sometimes occur, having been brought down by the floods from their usual habitat:—

1. The zone of Beeches.
2. The zone of shrubby *Compositæ* and *Scrophularineæ.*
3. The zone of Herbaceous plants.
4. The zone of perpetual Snow.

The lowest of these zones—that of beeches—is principally covered with grasses of a useful character, and patches of *Fagus solandri* and *F. cliffortioides*, which are almost the only trees of this zone. Both are valuable timber trees, and only require to be better known to be more appreciated. A number of shrubby species are common in this zone, such as species of *Korokia*, *Coprosma*, *Discaria*, *Dracophyllum*, *Podocarpus*, *Panax*, and *Pimelea.*

In a few breaks in the great Alpine chain, such as Arthur's Pass, a number of shrubs occur which do not properly belong to the Canterbury flora, but are escapes from the upland region of Westland, which contains very many plants different in character from those of Canterbury. Among these Westland plants may be mentioned the beautiful scarlet rata, *Metrosideros lucida*, the hini, *Dracophyllum traversii*, and the musk-tree, *Olearia colensoi*, all of which are found on Arthur's Pass, and are most magnificent plants. Some curious plants of the natural order *Umbelliferæ*, form a peculiar feature in the lower part of this zone. I refer to the species of *Aciphylla*, or spear-grass, which totally differ in aspect from any other known genus. This zone usually rises to about 3,800 feet, at which height the beeches generally cease suddenly, and are succeeded by dense masses of shrubby *Veronicas*, *Olearias*, and *Senecios*, which appear to me to form a well-defined zone. The great beauty of these shrubs has induced their cultivation in the gardens of the colony. The *Veronicas* number no less than forty distinct species, some of them of very extraordinary habit, and all, without exception, of great beauty.

Olearia has seven or eight fine species, and *Senecio* six ; all of which, together with the *Veronicas*, are confined to the colony, and not a few of them to the province of Canterbury. This zone rises to 4500 feet.

The zone of herbaceous plants ascends to 6000 feet, and occasionally to 7000 feet in the northern part of the province. It possesses an immense number of hardy species of beautiful appearance and most remarkable character. Prominent among them are the numerous species of *Celmisia*, the mountain forget-me-nots (*Exarrhena*), the well-known mountain lily (*Ranunculus lyallii*), and many other species of the same genus equally beautiful but not so well known, such as *Ranunculus godleyanus*—which is the finest of all known *Ranunculi*—*R. haastii*, *R. chordorhizos*, and *R. traversii.* The pretty white-flowered *Ourisias* are common, and also many others of equal beauty. The flowering plants which reach the highest elevations are *Forstera sedifolia* and *Abrotanella inconspicua*, both of which I have gathered at 7000 feet.

Cryptogams are very numerous both in this zone and the last, but are chiefly composed of *Musci*, *Lichenes*, and *Fungi*; *Filices* being represented by a very few species, chiefly of the genera *Hymenophyllum*, *Lomaria*, and *Polystichum*.

The Fourth Zone, that of perpetual snow, yields a few species of *Lichenes* and *Algæ*, but no flowering plants. The tree-ferns, which form such a prominent feature in most parts of the colony, are entirely absent from the Alps of Canterbury.

The nearest approach to the arboreal form in a fern occurs in *Polystichum nonindusiatum*, which frequently forms curious masses of root-fibres three or four feet high, and as much in diameter. Some of the *Hymenophylleæ* seem to be capable of enduring intense cold, for I have gathered *H. villosum* and *H. multifidum* on boulders embedded in a glacier.

The Alpine district cannot be said to have been even moderately well explored, and no doubt it contains many plants as yet unknown to science. It is to be hoped that some one will be able to explore these wonderful mountains in a more thorough manner than has ever yet been done, and the result will no doubt be highly satisfactory.

My catalogue gives the names of 496 species of flowering plants from the Alpine district, belonging to 164 genera.

The Forage Plants of Canterbury.—The forage plants of the province are numerous and important. They have contributed more than is generally admitted to bring about the present advanced state of settlement. Of these forage plants, those belonging to the *Gramineæ* or grasses are, of course, the most important. The grasses of Canterbury number about fifty species of varied relationship and various habit. Many of them are fully equal, as pasture, to any of the imported kinds, and will, I believe, be generally cultivated when their value becomes better understood by the farmers of the province.

The most nutritive grasses as far as I have been able to ascertain are the various species of *Danthonia*, *Microlæna avenacea*, and *Poa foliosa*; but these are not, however, the best adapted for cultivation, owing to their general coarseness of habit, and liability to die out. The best native grasses for general farm purposes are in my opinion the following, which fully deserve a trial from all farmers anxious to improve the productiveness of their pastures:—The rice grass, *Microlæna stipoides*. The long-awned plume grass, *Dichelachne crinita*. The brown bent, *Agrostis canina*, var. The Mount Cook bent, *Agrostis youngii*. The dwarf ring-grass, *Danthonia semi-annularis*. The blue wheat-grass, *Triticum squarrosum*. The short-flowered meadow-grass, *Poa breviglumis*. The leafy meadow-grass, *Poa foliosa*. The mountain tussock-grass, *Poa intermedia*. The native oat-

grass, *Trisetum antarcticum*, and the alpine holy-grass, *Hierochloe alpina.* Since the introduction of sheep and cattle these native grasses have considerably improved in productiveness, except where the senseless burning system has been carried to excess.

Besides the species of grasses we have several other plants which might be advantageously grown. For instance, the aromatic aniseed, *Angelica gingidium*, of which sheep are so fond that they have exterminated it in many parts of the province. This plant seeds freely enough where protected and would be easy to cultivate. *Ligusticum haastii*, another aromatic plant of the carrot tribe, is greedily eaten by horses and sheep and would be very easy of cultivation. *L. aromaticum*, *L. piliferum*, and *L. brevistyle* are similar in character. Many other sorts of plants are eaten by sheep, but I think the few here mentioned are all that are worthy of cultivation for pastoral purposes. It is to be hoped that the farmers of the province may be induced to cultivate these various forage plants, and to thoroughly test their value.

Summary of Catalogue.—My catalogue contains the names of 750 species of flowering plants, belonging to 236 genera; and 107 species of ferns, belonging to 34 genera. The lower Cryptogams are so incomplete that I do not think it worth while to summarize them here.

The largest orders are *Compositæ* with 110 species, *Scrophularineæ* 63 species. *Cyperaceæ* 55 species, *Gramineæ* 51 species, and *Umbelliferæ* 43 species. The largest genera are *Veronica*, with 44 species; *Celmisia*, 23 species; and *Ranunculus*, 22 species.

The great proportion of genera to species is a peculiar feature, thus no less than 109 genera have only one species each, and many others have only two. Again while 12 natural orders have 464 species, the remaining 286 species belong to no less than 65 orders, many of which have but one species each. Of the flowering plants—538 are confined to the colony, and 212 are found in other countries, 176 are found in Australia or Tasmania, and 108 species are natives of America. There are also 48 species closely allied to Australian plants, and 27 to South American. About 50 species are natives of Europe, and about 35 of Asia.

Of the 236 genera enumerated in the catalogue, no less than 25 are confined to New Zealand. The number of species confined to the Canterbury Province cannot be stated with any exactness until the flora of the adjoining provinces is properly worked up. It does not, however, exceed 20 species, and most probably not more than a dozen. The flora of New Zealand is usually considered by European botanical authors to be closely allied to that of Australia, and no doubt the two countries have a considerable number of plants in common. But the species common to Australia and

New Zealand are not—in either country—the plants which give a character to the vegetation. When I visited Australia in 1873, I explored about half of the colony of Victoria, and a large portion of New South Wales. In this extensive tract of country, containing two or three thousand species, I only observed about thirty or forty New Zealand plants, and they were by no means abundant. The common plants of the two countries are so very different, that I am forced to the conclusion that we must look elsewhere than Australia for the true relationship of our native flora. The space at my disposal here does not permit of any further reference to this very interesting subject, but I hope to return to it on some future occasion.

The Naturalized Plants.—No account, however short, of the plants of Canterbury would be complete without some reference to those plants which have been introduced through the agency of colonization. Wherever settlement extends the native plants rapidly die out, and their places are filled by British and other exotic plants, mostly of a very weedy nature. Indeed, the commonest species of plants in the province, at the present time, are introduced weeds such as the sorrel, *Rumex acetosella*, the white clover, *Trifolium repens*, and numerous kinds of British grasses.

These introduced plants are not all small herbs, shrubs are fairly represented, and trees are not altogether wanting. There can, I think, be no doubt whatever that the native vegetation will eventually be almost, if not entirely, exterminated, and the floral features of the country altogether changed through the introduction of these foreign weeds. When we consider that these plants have nearly all been introduced within the last twenty years, it is certainly surprising that they have already become so abundant.

The rapidity with which these introduced plants have spread over the province of Canterbury is indeed an extraordinary circumstance. A list of the introduced plants of Canterbury was laid before this Institute by my father on the 4th October, 1871; and I now furnish an additional list, making a total of 250 species. Most of the species contained in these two lists are common British weeds, very few of them possessing much beauty.

Along the roadside, throughout the province, may be found abundance of such plants as the common knot-weed, *Polygonum dryandri*. The chickweed, *Stellaria media*. The shepherd's purse, *Capsella bursa-pastoris*. The common docks, *Rumex obtusifolius* and *R. crispus*. The so-called Cape-weed, *Hypochæris radicata*. The wild stork's bill, *Erodium circutarium*. The Mayweed, *Matricaria chamomilla*. The mullem, *Verbascum thapsus*, and the hemlock, *Conium maculatum*. The most useful members of the introduced flora are the grasses, which abound everywhere, number more than forty species, and are still increasing in numbers. The common English water-

cress, *Nasturtium officinale*, has proved very troublesome in the rivers, where it attains a size and strength quite unknown in its native country. Another aquatic, the Canadian pond-weed, *Anacharis canadensis*, of recent introduction, is now abundant in the Avon and other rivers, where it seriously interferes with drainage and navigation. I am of opinion that the fact of the naturalization of foreign plants in New Zealand furnishes a key to the origin of large portions of the floras of other countries, notably of England and Italy.

No doubt many of the plants now considered indigenous to those countries have been introduced through the indirect agency of man—perhaps very many generations ago. I think that this theory is borne out by the fact that all countries widely separated from the great masses of land, and cut off from communication as New Zealand was before its discovery by Europeans, have very few species in common with other countries, and these chiefly such as might be carried by the sea, by stray birds, or by strong winds.

I have included in my catalogue of introduced plants a few species which are usually considered indigenous, but, after a careful examination of all the evidence obtainable, I am satisfied that they are really introduced, and have no claims to be considered indigenous; these are,—*Cyperus tenellus*, *Sporobolus elongatus*, *Kœleria cristata*, *Alopecurus geniculatus*, *Picris hieracioides*, and *Polygonum aviculare*.

Economic Plants of Canterbury.—The most important economic plants of the province are the timber trees, which have already been mentioned when describing the various districts in which they are found. In the way of plants fitted for human food, the native flora has very few species and they are in every way inferior—the two or three vegetables cultivated by the Maoris not being indigenous. The fruits eaten by the natives of the South Island were the berries of the pines, those of the *hinau*, the *karaka*, the *poroporo*, *Solanum aviculare*, and *Aristotelia racemosa;* few or none of which would be considered eatable by Europeans. The sea-side cress, *Lepidium oleraceum* and the New Zealand spinach, *Tetragonia trigyna*, have been used by English settlers as pot-herbs. Plants yielding fibre are both numerous and important. Foremost among them are the two species of flax or *Phormium*, which are now so well known throughout the world. The two kinds of cabbage-tree or *Cordyline* yield a fine soft white fibre, nearly as strong as and probably more valuable than the *Phormium*. *Astelia grandis* also yields a soft brown fibre of considerable strength, and is easily cultivated. Some of the coarser kinds of grasses, such as the tussock, *Poa cæspitosa*, *Aira*, *Apera*, etc., would no doubt yield fibres of some value. The whole of the fibre-plants mentioned here are very easy of cultivation,

and ought certainly to become a considerable source of income to the colony. There are, no doubt, many other plants found in the province from which valuable products of some kind might be obtained, and it is to be hoped that more attention will be given to this subject than has been in the past.

In conclusion, may I express a hope that some of the members of this Institute may be induced to study the native plants of the province, as much remains to be done in ascertaining the geographical and altitudinal range of the various Alpine species, and many new plants may yet be discovered in the more secluded mountain valleys.

In the *Cryptogams* much remains to be done in all the districts, in both collecting and arranging the species which have not been carefully sought for by any collector.

The catalogue attached to this paper I have made as complete as possible. The whole of the species enumerated have been collected by my father and myself, and the identification may be relied upon as correct. My studies and explorations, however, have been carried on during what little time could be spared from my regular employment, and I have, therefore, no doubt but that many additions will be made to our knowledge of the flora of Canterbury by future observers.

Catalogue of Canterbury Plants.

Abbreviations.—P., Banks Peninsula; L., Littoral; M., Lowland, or Middle District; A., Alpine; 3, Abundant; 2, Local; 1, Comparatively rare. All those not marked * are cultivated in the Christchurch Public Gardens.

PHÆNOGAMS.

Exogens.

Ranunculaceæ. 3—30.

Clematis indivisa, *Willd.* P.M.2.
hexasepala, *Fst.* P.M.2.
fœtida, *Raoul.* P.M.2.
parviflora, *Cunn.* P.M.2.
marata, *Armstrong.* L.M.A.2.
afoliata, *Buchanan.* P.1.
colensoi, *Hk.f.* P.M.1.
Ranunculus lyallii, *Hk.f.* A.2.
traversii, *Hk.f.* A.1.
pinguis, *Hk.f.* P.M.A.2.
godleyanus, *Hk.f.* A. 4–6000ft. 1.
geranifolius, *Hk.f.* A.2.
chordorhizos, *Hk.f.* A.2.
haastii, *Hk.f.* A. 5–7000ft. 1.
*crithmifolius, *Hk.f.* A.1.
sericophyllus, *Hk.f.* A.2.
*Ranunculus sinclairii, *Hk.f.* A.1.
hirtus, *B. et Sol.* P.M.A.3.
multiscapus, *Hk.f.* P.M.A.3.
*subscaposus, *Hk.f.* A.1.
*macropus, *Hk.f.* A.2.
rivularis, *B. et Sol.* P.M.2.
limosella, *F. Muell.* M.A.2.
*inundatus, *B. et Sol.* M.3.
*acaulis, *B. et Sol.* L.M.2.
triternatus, *Kirk.* M.2.
*gracilipes, *Hk.f.* A. 1.
*pachyrhizos, *Hk.f.* A.1.
sessiliflorus, *Br.* M.2.
*Caltha novæ-zealandiæ, *Hk.f.* A.1.

Magnoliaceæ.

Drimys colorata, *Raoul.* P.M.3.

Cruciferæ. 6—11.

*Nasturtium palustre, *DC.* M.A.2.
Sisymbrium novæ-zealandiæ, *Hk.f.* A.1.
Cardamine hirsuta, *L.* P.M.A.3.
*depressa, *Hk.f.* A.2. 2–4000ft.
fastigiata, *Hk.f.* A.2. 3000ft.
*Pachycladon novæ-zealandiæ, *Hk.f.* A. 4–5000ft.
Lepidium oleraceum, *Fst.* L.M.2.
*sisymbrioides, *Hk.f.* M.A.2.
*incisum, *B. et S., var.* alpinum. A.1.
Notothlaspi australe, *Hk.f.* A. 2–4000ft.
*rosulatum, *Hk.f.* A. 3000ft.

Violarieæ. 3—8.

Viola filicaulis, *Hk.f.* P.M.A.1.
lyallii, *Hk.f.* M.A.2.
cunninghamii, *Hk.f.* P.M.A.3.
Melicytus ramiflorus, *Fst.* P.2.
lanceolatus, *Hk.f.* P.M.1.
*micranthus, *Hk.f.* P.1.
Hymenanthera crassifolia, *Hk.f.* M.A.P.2.
angustifolia, *Hk.f.* A.1.

Pittosporeæ. 1—6.

Pittosporum tenuifolium, *B. et S.* P.M.3.
colensoi, *Hk.f.* M.A.2.
*rigidum, *Hk.f.* A.1.
obcordatum, *Raoul.* P.1.
fasciculatum, *Hk.f.* A. 2–4000ft. 2.
eugenioides, *A. Cunn.* P.M.3.

Caryophyllaceæ. 3—8.

Stellaria parviflora, *B. et S.* P.M.A.2.
roughii, *Hk.f.* A. 3–7000ft. 3.
gracilenta, *Hk. f.* A.3.
*Colobanthus quitensis, *Bar.* P.M.A.2.
billardieri, *Fenzl.* A.3.
subulatus, *Hk.f.* A.2.
acicularis, *Hk.f.* A.2.
*Spergularia media, *L.* L.M.2.

Portulaceæ. 3—3.

Claytonia australasica, *Hk.f.* L.M.P.A.3.
*Montia fontana, *Linn.* L.M.A.3.
*Hectorella cæspitosa, *Hk.f.* A.1. 4–6000ft.

Hypericineæ. 1—2.

Hypericum gramineum, *Fst.* P.M.2.
japonicum, *Thun.* P.L.M.A.3.

Malvaceæ. 2—4.

Plagianthus divaricatus, *Fst.* L.P.2.
betulinus, *Cunn.* P.M.A.3.
lyallii, *Hk.f.* A.3. 2–5000ft.
Hoheria angustifolia, *Raoul.* P.M.3.

Tiliaceæ. 2—6.

Aristotelia racemosa, *Hk.f.* P.M.3.
colensoi, *Hk.f.* A. 2000–4000ft.
fruticosa, *Hk.f.* P.A.3.
erecta, *Buch.* A.1.
Elæocarpus hookerianus, *Raoul.* P.M.3.
dentatus, *Vahl.* P.M.2.

Lineæ.

Linum monogynum, *Fst.* L.M.P.3.
*marginale, *A. Cunn.* Probably introduced. 1.

Geraniaceæ. 3—8.

Geranium patulum, *Fst.* P.M.A.G.
dissectum, *Hk.* non *Linn.*
microphyllum, *Hk.f.* P.M.L.3.
sessiliflorum, *Cav.* P.M.A.3.
molle, *Linn.* P.1.
Pelargonium clandestinum, *L'Hér.* L.P.M.A.3.
Oxalis corniculata, *Linn.* L.P.M.A.3.
stricta, *Linn.* M.P.A.2.
magellanica, *Fst.* A.2. 3–6000ft.

Diosmaceæ.

Melicope simplex, *Cunn.* P.M.3.

Olacineæ.

Pennantia corymbosa, *Fst.* P.3.

Stackhousieæ.

Stackhousia minima, *Hk.f.* A. 1. 3000ft.

Rhamneæ.

Discaria toumatou, *Raoul.* L.M.P.A.3.

Sapindaceæ. 2—2.

Dodonæa viscosa, *Fst.* L.P.2.
Alectryon excelsum, *DC.* P.3.

Anacardiaceæ.

Corynocarpus lævigata, *Fst.* Banks Peninsula only; perhaps an escape from cultivation.

Coriarieæ. 1—3.

Coriaria ruscifolia, *Linn.* P.M.A.3.

Coriaria thymifolia, *Humb.* A.2.
angustissima, *Hk.f.* A.3.

PAPILIONACEÆ. 4—12.

Carmichælia nana, *Col.* L.P.M.3.
(?) crassicaulis, *Hk.f.* A.2.
grandiflora, *Hk.f.* A.3.
pilosa, *Col. (?)* P.M.2.
australis, *Br.* L.P.M.3.
odorata, *Col.* M.A.1.
flagelliformis, *Col.* P.M.3.
juncea, *Col.* L.M.2.
monroi, *Hk.f.* A.M.2.
Notospartium carmichæliæ, *Hk.f.* M.1.
Swainsonia novæ-zealandiæ, *Hk.f.* A. 1.
Sophora microphylla, *Jacq.* P.M.3.
grandiflora, *Ait.* P.

ROSACEÆ. 4—14.

Rubus australis, *Fst.* P.M.2.
schmidelioides, *A. Cunn.* Leaves ovate.
cordata, *J.B.A.* Leaves cordate.
cissoides, *A. Cunn.* Leaves linear-oblong.
pauperata, *J.B.A.* Leaves reduced to ribs.
Potentilla anserinoides, *Raoul.* L.M. A.P. 3.
Geum magellanicum, *Com.* M.P.A.3.
parviflorum, *Com.* M.A. 3.
*uniflorum, *Buch.* A. 2.
Acæna anserinæfolium, *Fst.* P.M.A.3.
adscendens, *Vahl.* P.M.A. 3.
novæ-zealandiæ, *Kirk.* P.M. 2.
*microphylla, *Hk.f.* M.A. 2.
inermis, *Hk.f.* A. 2.

SAXIFRAGEÆ.

*Donatia novæ-zealandiæ, *Hk.f.* A. 3–5000ft. 1.

ESCALLONIACEÆ. 3—3.

*Quintinia serrata, *Cunn.* M.P.A. 1.
Carpodetus serratus, *Fst.* P.M. 3.
Weinmannia racemosa, *Fst.* A.2000ft.

CRASSULACEÆ. 1—3.

Tillæa moschata, *DC.* P.M.A.3.
*sinclairii, *Hk.* P.M.A.2.
muscosa, *Fst.* P.M.A. 1.

DROSERACEÆ. 1—4.

*Drosera arcturi, *Hk.f.* A. 2.
*spathulata, *Lab.* P.A. 2.
binata, *Lab.* L.P.M. 2.
*auriculata, *Back.* M. 1.

HALORAGEÆ. 4—12.

Haloragis alata, *Jacq.* L.P.M.A.3.
tetragyna, *Lab.* M.A. 3.
depressa, *Hk.f.* A. 2–4000ft. 2.
uniflora, *Kirk.* A. 3000ft. 2.
*aggregata, *Buch.* A. 2.
micrantha, *Br.* L.M.A. 2.
Myriophyllum elatinoides, *Gaud.* M. A. 1.
variæfolium, *Hk.f.* M.A. 3.
*pedunculatum, *Hk.f.* M. 1.
Gunnera monoica, *Raoul.* L.M.P.A.2.
*prorepens, *Hk.f.* M.A. 2.
Callitriche stagnalis, *L.* L.M.A.2.

MYRTACEÆ. 3—8.

Leptospermum scoparium, *Fst.* P. M.L. 3.
ericoides, *Rich.* P.L.M. 2.
Metrosideros lucida, *Menz.* A. 1–3000 ft.
hypericifolia, *Cunn.* P.M.A. 2.
colensoi, *Hk.f.* P. 2.
*scandens, *B. et S.* P. 2.
Myrtus obcordata, *Hk.f.* P. 2.
pedunculata, *Hk.f.* P.M. 2.

ONAGRARIEÆ. 2—17.

Fuchsia excorticata, *Linn.f.* P.M. 3.
colensoi, *Hk.f.* P.M. 3.
Epilobium pendulum, *B. et S.* P.M. A. 3.
purpuratum, *Hk.f.* P.M.A. 3.
linnæoides, *Hk.f.* A. 1.
*macropus, *Hk.* P.M.A. 2.
confertifolium, *Hk.f.* M.A. 3.
*crassum, *Hk.f.* M.A. 3.
*alsinoides, *Cunn.* A. 1.
microphyllum, *Rich.* P.M.A. 3.
rotundifolium, *Fst.* P.M.A. 3.
glabellum, *Fst.* L.P.M.A. 2.
melanocaulon, *Hk.* M.A. 2.
junceum, *Fst.* L.M.P. 3.
*pubens, *Rich.* L.M.P. 3.
billardierianum, *Ser.* P.M. 3.
pallidiflorum, *Sol.* P.M.A. 3.

PASSIFLOREÆ.

Passiflora tetrandra, *B. et Sol.* P.2.

FICOIDEÆ. 2—2.

Mesembryanthemum australe, *B. et S.* L. 3.
Tetragonia trigyna, *B. et S.* L. 2.

UMBELLIFERÆ. 11—43.

Hydrocotyle elongata, *Cunn.* P.M.A.2.

*Hydrocotyle americana, *Linn.* M. P.A. 3.
asiatica, *Linn.* P.L.M.A.3.
*muscosa, *Br.* P.M.A. 2.
dissecta, *Hk.f.* P.M.A. 3.
novæ-zealandiæ, *DC.* A.P. 2.
*moschata, *Fst.* M.P.A. 2.
*microphylla, *Cunn.* A.M. 1.
* n. sp. (?). A. 1.
Pozoa exigua, *Hk.f.* A. 3–6500ft. 3.
haastii, *Hk.f.* A. 3–4000ft. 2.
hydrocotyloides, *Hk.f.* P.M.A.3.
*trifoliolata, *Hk.f.* A. 3000ft. 2.
roughii, *Hk.f.* A. 4000ft. 2.
Crantzia lineata, *Nutt.* L.P.M.A. 3.
,, *var.* aquatica. M. 3.
Apium australe, *Thoms.* L. 3.
*filiforme, *Hk.* L. 2.
Eryngium vesiculosum, *Lab.* L. 3.
Oreomyrrhis colensoi, *Hk.f.* A.M. 3.
haastii, *Hk.f.* A. 3.
*ramosa, *Hk.f.* A. 2.
n. sp. (?) A. 2000ft.
Aciphylla squarrosa, *Fst.* L.M.P.A.3.
colensoi, *Hk.f.* M.A. 3.
lyallii, *Hk.f.* A. 3.
monroi, *Hk.f.* A. 2–5000ft. 3.
*montana, *Armstrong.* A. 3000 ft. 1.
*crenulata, *J.B.A.* A. 4–6000ft. 1.
*dobsoni, *Hk.f.* A. 4–6000ft. 1.
Ligusticum haastii, *F. Muell.* A. 2–5000ft. 2.
*brevistyle, *Hk.f.* A. 1.
filifolium, *Hk.f.* A. 2–3000ft. 2.
carnosulum, *Hk.f.* A. 3–5000ft. 2.
piliferum, *Hk.f.* P.A. 2–4000 ft. 2.
aromaticum, *B. et S.* P.M.A. 3.
imbricatum, *Hk.f.* A.2.
*trifoliolatum, *Hk.f.* A.2000ft. 1.
Angelica gingidium, *Hk.f.* L.P.M. A.3.
decipiens, *Hk.f.* Ligusticum enysi, *Kirk* (?) A.2.
rosæfolia, *Hk.f.* P.M.2.
geniculata, *Hk.f.* P.M.3.
Daucus brachiatus, *Sieb.* L.P.M.A.3.

ARALIACEÆ. 2—9.

Panax simplex, *Fst.* P.M.A.3.
*edgerleyi, *Hk.f.* A.1. 2000ft.
*Panax anomalum, *Hk.f.* A.1.
*lineare, *Hk.f.* A. 3000ft. 3.
crassifolium, *D. et Pl.* P.M.3.
longissimum, *Buch.* P.M.3.
colensoi, *Hk.f.* P.A. 1–4000ft. 3.
arboreum, *Fst.* P.M.3.
sp. P.A.2.
Schefflera digitata, *Fst.* P.M.2.

CORNEÆ. 2—2.

Griselinia littoralis, *Raoul.* P.M.3.
,, **var.* alpina. A. 2–4000ft.
Corokia cotoneaster, *Raoul.* P.M.A.3.

LORANTHACEÆ. 3—9.

*Loranthus colensoi, *Hk.f.* A.2.
tetrapetalus, *Fst.* A.2.
*tenuiflorus, *Hk.f.* A.2.
decussatus, *Kirk.* A.3.
*flavidus, *Hk.f.* A.2.
micranthus, *Hk.f.* P.M.A.3.
*Tupeia antarctica, *Ch. et Schl.* P.M.2.
*Viscum salicornioides, *Cunn.* P.M.2.
*lindsayi, *Oliver.* P.M.3.

RUBIACEÆ. 5—25.

Coprosma lucida, *Fst.* P.M.3.
robusta, *Raoul.* P.M.3.
cunninghamii, *Hk.f.* P.M.3.
rotundifolia, *Cunn.* P.M.A.3.
tenuicaulis, *Hk.f.* P.M.3.
rhamnoides, *Cunn.* P.M.3.
divaricata, *Cunn.* P.M.3.
parviflora, *Hk.f.* L.P.M.3.
propinqua, *Cunn.* P.M.3.
fœtidissima, *Fst.* P.M.A.2.
pusilla, *Fst.* P. (?) 1.
cuneata, *Hk.f.* P.M.A.3.
acerosa, *Hk.f.* L.P.M.A.3.
depressa, *Col.* (?) A.3.
microcarpa, *Hk.f.* (?) P.A.2.
linariifolia, *Hk.f.* P.M.A.3.
repens, *Hk.f.* A.3. 4–7000ft.
*pumila, *Hk.f.* A.3. 4–6000ft.
serrulata, *Hk.f.* A. 2–3000ft. 3.
Asperula perpusilla, *Hk.f.* A.P.M.3.
Nertera depressa, *B. et Sol.* P.A.3.
dichondræfolia, *Hk.f.* A.2.
cæspitosa, *J.B.A.* n.s. Densely tufted, flowers diœcious. A.2.
Galium umbrosum, *Fst.* P.M.A.2.
tenuicaule, *A. Cunn.* P.M.A.3.

COMPOSITÆ. 20—111.

Olearia colensoi, *Hk.f.* A. 3000ft. 1.
nitida, *Hk.f.* P.M.A.3.

Olearia dentata, *Hk.f.* A. 1–2500ft. 2.
ilicifolia, *Hk.f.* A. 1–3000ft. 2.
*lacunosa, *Hk.f.* A. 3000ft. 1.
haastii, *Hk.f.* A. 2–4000ft. 2.
cymbifolia, *Hk.f.* A.2.
moschata, *Hk.f.* A.3.
nummularifolia, *Hk.f.* A.3.
forsteri, *Hk.f.* P.M.A.3.
avicenniæfolia, *Hk.f.* P.M.A.3.
virgata, *Hk.f.* P.M.A.3.
hectori, *Hk.f.* P.2.
angustata, *Armstrong.* A.1.
*Celmisia densiflora, *Hk.f.* A. 2.
discolor, *Hk.f.* A. 3–5000ft. 3.
walkeri, *Kirk.* A.1.
hieracifolia, *Hk.f.* A.1.
*haastii, *Hk.f.* A. 3–5000ft. 2.
incana, *Hk.f.* A.3.
*sinclairii, *Hk.f.* A.2.
verbascifolia, *Hk.f.* M.2.
coriacea, *Hk.f.* P.A.3.
*mackaui, *Raoul.* P.1.
monroi, *Hk.f.* A. 3–6000ft. 3.
linearis, *J.B.A.*, n. sp. Leaves 2 to 4 inches long, linear, densely covered with close white cotton, flowers not seen; forms broad dense patches in the Alps. A. 3000ft. 3.
lyallii, *Hk.f.* P.A. 1–3000ft. 3.
viscosa, *Hk.f.* A.3.
petiolata, *Hk.f.* A.2.
spectabilis, *Hk.f.* P.M.A.3.
traversii, *Hk.f.* (?) 1.
longifolia, *Cass.* P.L.M.A.3.
*laricifolia, *Hk.f.* A.2.
*hectori, *Hk.f.* A.1.
sessiliflora, *Hk.f.* A. 3–6000ft. 3.
bellidioides, *Hk.f.* A. 2–4000ft. 3.
*glandulosa, *Hk.f.* A. 3000ft.3.
Vittadinia australis, *Rich.* L.M.P.3.
Lagenophora forsteri, *DC.* M.P.A.2.
petiolata, *Hk.f.* M.P.A.3.
*pinnatifida, *Hk.f.* A.1.
Brachycome sinclairii, *Hk.f.* A.3.
*Abrotanella pusilla, *Hk.f.* A. 3–6000 ft. 1.
*inconspicua, *Hk.f.* A. 3–6000 ft. 1.
Cotula coronopifolia, *Linn.* L.M.P. A.3.
tenella, *Cunn.* M.A.2.
*atrata, *Hk.f.* A. 3–5500ft. 2.
Cotula minor, *Hk.f.* M.A.3.
filiformis, *Hk.f.* M.1.
pectinata, *Hk.f.* P.M.3.
pyrethrifolia, *Hk.f.* P.M.A.3.
*perpusilla, *Hk.f.* M.1.
*dioica, *Hk.f.* P.M.3.
squalida, *Hk.f.* P.M.3.
*minuta, *Fst.* M.A.2.
Craspedia fimbriata, *DC.* P.M.L. A.3.
alpina, *Back.* P.M.A.3.
Cassinia fulvida, *Hk.f.* P.M.A.1.
vauvilliersii, *Hk.f.* P.M.L.A.3.
Ozothamnus glomeratus, *Hk.f.* P.3.
microphyllus, *Hk.f.* A.3.
depressus, *Hk.f.* A.3.
Raoulia australis, *Hk.f.* L.M.P.A.3.
tenuicaulis, *Hk.f.* P.M.A.3.
haastii, *Hk.f.* A.M.2.
monroi, *Hk.f.* M.3.
*subulata, *Hk.f.* A.2.
eximia, *Hk.f.* A. 4000ft. 1.
*hectori, *Hk.f.* M.A.2.
glabra, *Hk.f.* M.A.3.
subcericea, *Hk.f.* M.A.3.
grandiflora, *Hk.f.* A.1. 3–6000ft.
*mamillaris, *Hk.f.* A. 5000ft. 1.
*bryoides, *Hk.f.* M.A.2.
Gnaphalium prostratum, *Hk.f.* P.A. M.1.
bellidioides, *Hk.f.* P.M.A.3.
youngii, *Hk.f.* A.1.
*lyallii, *Hk.f.* A.1.
trinerve, *Fst.* A.1.
filicaule, *Hk.f.* P.M.A.3.
*traversii, *Hk.f.* A.2.
*luteo-album, *L.* L.M.P.A.3.
grandiceps, *Hk.f.* A.2.
involucratum, *Fst.* M.P.A.3.
collinum, *Lab.* M.P.3.
Haastia recurva, *Hk.f.* A. 3–7000 ft. 2.
*sinclairii, *Hk.f.* A. 3–4000ft. 2.
*sp. nov., *Mt. White.* A.1.
Erechtites prenanthoides, *DC.* M.A.2.
arguta, *DC.* L.M.P.A. 3.
* scaberula, *Hk.f.* M.A.2.
quadridentata, *DC.* M.P.A.3.
*pumila, *J.B.A.* M.2.
Senecio lagopus, *Raoul.* L.M.P.A.2.
bellidioides, *Hk.f.* L.M.P.A.3.
saxifragoides, *Hk.f.* P.2.
*haastii, *Hk.f.* A.2.
lautus, *Fst.* L.M.P. 3.

Senecio odoratus, *Horn*, var. *banksii.* P.2.
lyallii, *Hk.f.* A.3.
sciadophilus, *Raoul.* P.2.
elæagnifolius, *Hk.f.* A. 2–4000 ft. 3.
buchanani, *Armstrong.* A. 3000 ft. 1.
bidwillii, *Hk.f.* A.2.
cassinioides, *Hk.f.* A.3.
pottsii, *Armstrong.* A. 4–5000 ft. 1.
Traversia baccharoides, *Hk.f.* A. 2–3000ft. 1.
Microseris forsteri, *Hk.f.* M.P.A.2.
Crepis novæ-zealandiæ, *Hk.f.* M.A.2.
Taraxacum dens-leonis, *Des.* var. *minor.* M.P.A.3.
Sonchus aspera, *Vill.* M.P.A.2.

Stylidieæ. 2—5.

Forstera sedifolia, *Linn. fil.* A. 4–7000ft. 2.
*tenella, *Hk.f.* A. 4–7000ft. 2.
*Helophyllum clavigerum, *Hk.f.* A. 4–6000ft. 2.
*colensoi, *Hk.f.* A. 3–6000ft. 2.
*rubrum, *Hk.f.* A. 3–6000ft. 2.

Campanulaceæ. 1—3.

Wahlenbergia gracilis, *DC.* L.M.P. A. 3.
capillaris, *DC.* M.P. 3.
saxicola, *DC.* A.M.3.

Lobeliaceæ. 3—7.

Lobelia anceps, *Thun.* P.M.A.2.
roughii, *Hk.f.* A. 4–5000ft. 3.
Pratia angulata, *Hk.f.* M.P.A.L.3.
macrodon, *Hk.f.* A.2.
linnæoides, *Hk.f.* A.2.
Selliera radicans, *Cav.* L.P.2.
*fasciculata, *Buch.* M.2.

Ericeæ. 2—3.

Gaultheria rupestris, *Br.* A.P.3.
antipoda, *Fst.* A.P.3.
Pernettya tasmanica, *Hk.f.* A.2.

Epacridaceæ. 6—17.

Cyathodes acerosa, *Br.* P.3.
empetrifolia, *Hk.f.* A.2.
colensoi, *Hk.f.* A.3.
Leucopogon fasciculatus, *Rich.* P.M.3.
frazeri, *Cunn.* L.M.P.A.3.
Pentachondra pumila, *Br.* A.3.
*Epacris alpina, *Hk.f.* A.2.
Archeria traversii, *Hk.f.* A.3.
Dracophyllum traversii, *Hk.f.* A. 3000ft. 1.
*menziesii, *Hk.f.* A.2.
strictum, *Hk.f.* A.3.
longifolium, *Br.* A.2.
urvilleanum, *Hk.f.* A.3.
scoparium, *Hk.f.* A.3.
uniflorum, *Hk.f.* M.P.A.3.
rosmarinifolium, *Fst.* A.3.
*muscoides, *Hk.f.* A. 3–6000ft.3.

Myrsineæ. 1—3.

Myrsine urvillei, *DC.* P.3.
divaricata, *Cunn.* P.A.3.
nummularia, *Hk.f.* P.A.2.

Primulaceæ.

Samolus repens, *F. Muell.* L.3.

Apocyneæ.

Parsonsia albiflora, *Raoul.* P.M.3.
rosea, *Raoul.* P.M.3.

Loganiaceæ.

Logania ciliolata, *Hk.f.* A.3.
*tetragona, *Hk.f.* A.2.

Gentianeæ. 2—6.

Gentiana montana, *Fst.* M.P.A.3.
novæ-zealandiæ, *Armstrong.* A. 2000ft. 1.
pleurogynoides, *Griseb.* M.A.2.
saxosa, *Fst.* A.2.
hookeri, *J. B. A.* A. *G. saxosa* var. γ, *Hk.f.*
*Sebæa ovata, *Br.* L.P.M.3.

Boragineæ. 2—10.

Myosotis uniflora, *Hk.f.* A. 3–5000ft. 2.
*pulvinaris, *Hk.f.* A.2.
*spathulata, *Fst.* P.M.2.
antarctica, *Hk.f.* P.M.A.3.
australis, *Br.* P.M.A.2.
*forsteri, *Hk.f.* P.2.
capitata, *Hk.f.* P.2.
*traversii, *Hk.f.* A.2.
*Exarrhena petiolata, *Hk.f.* (?) A.2.
macrantha, *Hk.f.* A.3.

Convolvulaceæ. 2—5.

Convolvulus tuguriorum, *Fst.* P. M.3.
*sepium, *Linn.* L.M.P.3.
soldanella, *Linn.* L.P.3.
erubescens, *Br.* P.M.A.3.
*Dichondra repens, *Fst.* M.P.A.2.

SOLANEÆ.

Solanum aviculare, *Fst.* P.3.

SCROPHULARINEÆ. 8—62.

Mimulus repens, *Br.* L.M.3.
*Mimulus repens, *var.* colensoi (M. colensoi, *Kirk*). L.M.3.
radicans, *Hk.f.* M.A.3.
Mazus pumilio, *Br.* L.M.P.3.
Gratiola nana, *Benth.* P.M.3.
Limosella tenuifolia, *Nutt.* M.A.2.
Veronica stricta, *B. et. S.* M.P.3.
kirkii, *Armstrong.* A. 3–4000ft.2.
parviflora, *Vahl.* M.2.
ligustrifolia, *Cunn.* P.M.3.
traversii, *Hk.f.* A.M.2.
vernicosa, *Hk.f.* A.P.3.
anomala, *Armstrong.* A. 3000ft. 2.
elliptica, *Fst.* P.M.2.
colensoi, *Hk.f.* P.A.3.
lævis, *Benth.* A.2.
obovata, *Kirk.* A.2.
buxifolia, *Benth.* A.2.
haustrata, *Armstrong.* A. 2000ft. 2.
carnosula, *Hk.f.* A.2.
amplexicaulis, *Armstrong.* A. 3–4000ft.
pinguifolia, *Hk.f.* A.2.
decumbens, *Armstrong.* A.2.
buchanani, *Hk.f.* (?) A. 4000ft.1.
pimeleoides, *Hk.f.* A.2.
glauco-cærulea, *Armstrong.* A.2.
lycopodioides, *Hk.f.* A. 4000ft.2.
tetrasticha, *Hk.f.* A. 50000ft. 1.
hectori, *Hk.f.* A. 4–5000ft. 2.
salicornioides, *Hk.f.* A.2.
armstrongii, *Johns. Hort.* A. 4–6000ft. 2.
cupressoides, *Hk.f.* P.A.3.
haastii, *Hk.f.* A. 4–6000ft. 2.
epacridea, *Hk.f.* A. 4–7000ft. 2.
*macrantha, *Hk.f.* A. 4–6000ft. 2.
hulkeana, *F. Muell.* M.2.
sp. nov. M.2.
gracilis, *Armstrong.* A.2.
lavaudiana, *Raoul.* P.2.
raoulii, *Hk.f.* P.2.
linifolia, *Hk.f.* A. 5000ft. 3.
lyallii, *Hk.f.* A.3.
bidwillii, *Hk.f.* A.3.
cataractæ, *Fst.* M.1.
Veronica lanceolata, *Benth.* M.P.1.
canescens, *Kirk.* L.M.A.3.
loganioides, *Armstrong.* A. 5000ft. 1.
greyii, *Armstrong.* A. 3–5000ft. 1.
canterburiense, *Armstrong.* A. 4–5000ft. 1.
montana, *Armstrong.* A.3000ft.2.
*Pygmea ciliolata, *Hk.f.* A.2.
*pulvinaris, *Hk.f.* A.2.
Ourisia macrophylla, *Hk.f.* P.A.3.
macrocarpa, *Hk.f.* A. 3000ft. 2.
*sessilifolia, *Hk.f.* A.2.
cæspitosa, *Hk.f.* A.3.
*glandulosa, *Hk.f.* A.2.
*n. sp. (?) A.2.
Euphrasia cuneata, *Fst.* L.M.3.
*monroi, *Hk.f.* M.P.3.
*revoluta, *Hk.f.* A. 3–5000ft. 3.
antarctica, *Benth.* A. 4–6000ft. 3.

LENTIBULARIEÆ.

Utricularia novæ-zealandiæ, *Hk.f.* L. 2.
monanthus, *Hk.f.* L.M.P.A.3.

VERBENACEÆ. 2—2.

Teucridium parvifolium, *Hk.f.* L.P. A.3.
Myoporum lætum, *Fst.* P.3.

LABIATÆ. 2—2.

Micromeria cunninghamii, *Benth.* L. M.P.A.3.
*Scutellaria novæ-zealandiæ, *Hk.f.* P.A.2.

PLANTAGINEÆ. 1—4.

*Plantago brownii, *Rapin.* M.A.P.2.
lanigera, *Hk.f.* A.2.
spathulata, *Hk.f.* M.A.3.
raoulii, *Decaisne.* P.M.A.3.

CHENOPODIACEÆ. 5—8.

Chenopodium triandrum, *Fst.* L.P.2.
*ambiguum, *Br.* P.1.
carinatum, *Br.* M.3.
detestens, *Kirk.* M.A.3.
*Suæda maritima, *Dum.* L.2.
*Atriplex cinerea. *Poir.* L.2.
*Salsola australis, *Br.* L.2.
Salicornia australis, *Fst.* L.3.

PARONYCHIEÆ.

Scleranthus biflorus, *Hk.f.* L.M.P.3.

POLYGONEÆ. 3—7.

Polygonum decipiens, *Br.* L.M.3.

Muhlenbeckia adpressa, *Lab.* M.P. A.3.
Muhlenbeckia adpressa, *var.* truncata. P.1.
complexa, *Meis.* L.M.P.A.3.
axillaris, *Hk.f.* L.M.P.A.3.
ephedroides, *Hk.f.* M.3.
Rumex flexuosus, *Fst.* L.M.P.A.3.
*neglectus, *Kirk.* L.1.

Monimiaceæ.

Hedycarya dentata, P.3.

Thymeleæ. 2—9.

*Pimelea gnidia, *Fst.* A. 2.
traversii, *Hk.f.* A. 3.
virgata, *Vahl.* L. 3.
arenaria, *Cunn.* A. 3.
prostrata, *Vahl.* L.M.A.P. 3.
lyallii, *Hk.f.* A. 3.
*sericeo-villosa, *Hk.f.* A. 2.
*Drapetes dieffenbachii, *Hk.* A. 3–5000ft. 3.
*lyallii, *Hk.f.* A. 2.

Santalaceæ.

Exocarpus bidwillii, *Hk.f.* M.A. 2–4000ft. 2.

Euphorbiaceæ.

Euphorbia glauca, *Fst.* L.P. 3.

Cupuliferæ. 1—4.

Fagus menziesii, *Hk.f.* M. 1.
Fagus fusca, *Hk.f.* P.M. 1.
solandri, *Hk.f.* P.(?)M.A. 3.
cliffortioides, *Hk.f.* P.(?)M.A. 3.

Urticaceæ. 4—6.

Epicarpurus microphyllus, *Raoul.* P.M. 3.
Urtica ferox, *Fst.* P.M. 3.
incisa, *Poir.* M.P.A. 3.
*australis, *Hk.f.* A. 3.
*Parietaria debilis, *Fst.* P. 2.
*Australina pusilla, *Gaud.* P. 1.

Piperaceæ.

Macropiper excelsum, *Seem.* P. 2.

Coniferæ. 4—13.

Libocedrus doniana, *End.* P. 1.
bidwillii, *Hk.f.* A. 2–3300ft. 3.
Podocarpus ferruginea, *Don.* P.M. 3.
nivalis, *Hk.f.* A. 3.
spicata, *Br.* P.M. 3.
totara, *Cunn.* P.M. 3.
dacrydioides, *Rich.* P.M. 3.
Dacrydium cupressinum, *Sol.* P.M. 3.
*colensoi, *Hk.* A.1.
*westlandicum, *Kirk.* A.1.
*bidwillii, *Kirk.* A. 4000ft. 3.
laxifolium, *Hk.f.* A. 5000ft. 3.
Phyllocladus alpinus, *Hk.f.* A. 3000 ft. 3.

ENDOGENÆ.

Orchideæ. 12—25.

Earina mucronata, *Lind.* P.3.
autumnalis, *Hk.f.* P.3.
Dendrobium cunninghamii, *Lind.* P. M.2.
*pygmæum, *Smith.* P.2.
*Gastrodia cunninghamii, *Hk.f.* M. P.2.
Cyrtostylis oblonga, *Hk.f.* A.P.1.
Corysanthes triloba, *Hk.f.* P.M.A. 2.
*rotundifolia, *Hk.f.* M.P.2.
*rivularis. *Hk.f.* P.2.
macrantha, *Hk.f.* P.M.3.
Microtis porrifolia, *Spr.* L.M.3.
*Caladenia minor, *Hk.f.* A.P.1.
*lyallii, *Hk.f.* A.P.2.
bifolia, *Hk.f.* A.1.
Pterostylis banksii, *Br.* L.M.3.
graminea, *Hk.f.* L.M.2.
micromega, *Hk.f.* A.1.
*Pterostylis foliata, *Hk.f.* A.1.
*trullifolia, *Hk.f.* A.1.
Chiloglottis cornuta, *Hk.f.* (?). P. A.2.
*Lyperanthus antarcticus, *Hk.f.* P. A.3.
Thelymitra longifolia, *Fst.* L.M.3.
*uniflora, *Hk.f.* M.P.2.
Prasophyllum colensoi, *Hk.f.* M.3.
*nudum, *Hk.f.* M.1.

Irideæ. 1—4.

Libertia ixioides, *Spreng.* P.3.
vestioides, *Klatt.* P.2.
grandiflora, *Sweet.* P.M.3.
*micrantha, *Cunn.* P.A.2.

Melanthaceæ.

Anguillaria novæ-zealandiæ, *Hk.f.* MS. M.3.

Hypoxideæ.

Hypoxis pusilla, *Hk.f.* M.3.

TYPHACEÆ.

Typha latifolia, *Linn.* M.P.3.
*angustifolia, *Linn.* M.A.2.

NAIADEÆ. 5—7.

*Lemna minor, *Linn.* M.P.A.3.
Triglochin triandrum, *Mich.* M.L. P.A.3.
Potamogeton natans, *Linn.* M.P.L. A.2.
*gramineus, *Linn.* P.1.
*compressus, *Linn.* P.A.1.
*Ruppia maritima, *Linn.* L.2.
*Zostera marina, *Linn.* (?) L.1.

LILIACEÆ. 9—15.

Rhipogonum scandens, *Fst.* P.M.3.
Callixene parviflora, *Hk.f.* A.2.
Cordyline australis, *Hk.f.* (?) M.P.3.
hookeri, *Kirk.* (C. indivisa ?) P.3.
veitchi, *Hort.* P.2.
Dianella intermedia, *End.* P.M.3.
Astelia grandis, *Kirk.* M.P.3.
nervosa, *Fst.* P.A.3.
solandri, *Cunn.* P.A.2.
*linearis, *Hk.f.* A.P.2.
Arthropodium candidum, *Raoul.* P. A.3.
Anthericum hookeri, *Col.* L.M.P.A.3.
Phormium tenax, *Fst.* L.M.P.A.3.
colensoi, *Fst.* P.A.2.
*Herpolirion novæ-zealandiæ, *Hk.f.* A.2.

PALMEÆ.

Areca sapida, *Fst.* P.3.

JUNCEÆ. 8—16.

Juncus vaginatus, *Br.* P.M.3.
*australis, *Hk.f.* M.3.
maritimus, *Lam.* L.M.3.
*effusus, *Linn.* M.3.
*planifolius, *Br.* M.A.3.
bufonius, *Linn.* M.P.A.3.
*holoschœnus, *Br.* M.P.A.2.
*scheuzerioides, *Gaud.* A.P.2.
*antarcticus, *Hk.f.* (?) M.A.2.
*novæ-zealandiæ, *Hk.f.* A.M.3.
*pauciflorus, *Kirk.* (J. novæ-zealandiæ ?) A.2.
*Rostkovia magellanica, *Hk.f.* A.M. P.3.
*gracilis, *Hk.f.* A.M.3.
Luzula campestris, *DC.* P.M.A.3.
*picta, *Rich.* A.P.M.2.
*oldfieldii, *Hk.f.* M.P.A.2.
pumila, *Hk.f.* A.3.

RESTIACEÆ. 2—4.

Leptocarpus simplex, *Rich.* L.M.3.
*Gaimardia ciliata, *Hk.f.* A.3.
*setacea, *Hk.f.* A.2.
*pallida, *Br.* A.2.

CYPERACEÆ. 14—55.

*Cyperus ustulatus, *Rich.* M.P.2.
*tenellus, *Linn. f.* M.P.3. Naturalized ?
Schœnus axillaris, *Hk.f.* M.P.A.3.
*tenax, *Hk.f.* P.A.2.
*pauciflorus, *Hk.f.* P.M.A.3.
Carpha alpina, *Br.* A.2.
*Scirpus fluitans (?) L.M.P.3.
*maritimus, *Linn.* L.3.
*triqueter, *Linn.* L.3.
*lacustris, *Linn.* L.3.
Eleocharis sphacelata, *Br.* L.1.
gracillima, *Br.* L.M.P.A.3.
gracilis, *Br.* M.P.A.3.
*Isolepis nodosa, *Br.* P.M.A.2.
prolifer, *Br.* P.M.A.3.
riparia. *Br.* P.A.3.
*aucklandica, *Hk.f.* A.2.
*Desmoschœnus spiralis, *Hk.f.* L. 3.
*Fimbristylis dichotoma, *Vahl.* P.M. 2.
*Cladium glomeratum, *Br.* P.A. 2.
*teretifolium, *Br.* P.A. 2.
*junceum, *Br.* A. 2.
*Gahnia setifolia, *Hk.f.* P.M. 2.
*procera, *Fst.* P.M. 3.
*lacera, *Steud.* P.M.A. 2.
ebonocarpa, *Hk.f.* P.M. 2.
*arenaria, *Hk.f.* M. 2.
*Lepidosperma tetragona, *Lab.* L. M. 3.
*Oreobolus pumilio, *Br.* A. 2.
*Uncinia leptostachya, *Raoul.* P.M. A. 3.
*australis, *Pers.* P.M.A. 3.
*ferruginea, *Boott.* P.A. 2.
*rupestris, *Raoul.* P. 2.
*banksii, *Boott.* P. 2.
Carex pyrenaica, *Wahl.* M.P.A. 2.
*acicularis, *Boott.* M.A. 3.
*inversa, *Br.* P.M.A. 2.
*colensoi, *Hk.f.* P.M.A. 2.
*stellulata, *Good.* P.M.A. 2.
*teretiuscula, *Good.* P.M.A. 2.
virgata, *Sol.* L.M.P.A. 3.
*gaudichaudiana, *Kunth.* M.A. 2.
*subdola, *Boott.* M.A. 2.

Carex ternaria, *Fst.* L.M.P.A. 3.
*testacea, *Sol.* M.P.A. 2.
*raoulii, *Boott.* P.M.A. 2.
lucida, *Boott.* P.A. 3.
*pumila, *Thun.* L.M.P.A. 3.
*forsteri, *Wahl.* M.P.A. 3.
*cataractæ, *Br.* A.P. 2.
*breviculmis, *Br.* A.P. 3.
trifida, *Cav.* P.A.M. 2.
*dissita, *Sol.* P.M.A.2.
*lambertiana, *Boott.* M.A.2.
*vacillans, *Sol.* P.2.

GRAMINEÆ. 20—51.

Microlæna stipoides, *Br.* L.M.1. Very rare.
avenacea, *Hk.f.* P.M. 3.
*polynoda, *Hk.f.* P.3.
*(Alopecurus geniculatus, *L.*) Naturalized. M. 2.
Hierochloe redolens, *Br.* L.M.P.A.3.
alpina, *R. et Sch.* A. 2–5000ft. 2.
*Spinifex hirsutus, *Lab.* L.2.
*Panicum imbecille, *Trin.* P.2.
Zoysia pungens, *Willd.* L.M.P.3.
Echinopogon ovatus, *Pal.* P.M.A.3.
Dichelachne sciurea, *Hk.f.* L.1.
crinita, *Hk.f.* M.P.A.3.
Apera arundinacea, *Hk.f.* P.M.A.3.
*(Sporobolus elongatus). Naturalized. M.1.
Agrostis canina, *Linn., var.* P.M.A.3.
*parviflora, *Br.* M.A.3.
æmula, *Br.* M.P.A.3.
pilosa, *Rich.* M.P.A.3.
billardieri, *Br.* L.M.3.
*setifolia, *Hk.f* (?). A.M.2.
*avenoides, *Hk.f.* A.3.
*Agrostis youngii, *Hk.f.* A.2.
quadriseta, *Br.* P.M.A.3.
Arundo conspicua, *Fst.* P.M.A.3.
Danthonia cunninghamii, *Hk.f.* A.3.
raoulii, *Steud.* P.A.3.
*flavescens, *Hk.f.* A.2.
semi-annularis, *Br.* M.P.A.3.
*pauciflora, *Benth.* A. 3000ft. 3.
*buchanani, *Hk.f.* A.2.
*Aira cæspitosa, *Pal.* L.M.P.A.3.
*(Kœleria cristata). Naturalized. M.2.
Trisetum antarcticum, *Trin.* M.P. A.3.
*subspicatum, *Pal.* A.2.
*youngii, *Hk.f.* A.2.
Glyceria stricta, *Hk.f.* L.M.P.3.
Poa imbecille, *Fst.* P.M.3.
breviglumis, *Hk.f.* P.M.L.3.
foliosa, *Hk.f.* M.P.A.3.
anceps, *Fst.* M.P.A.3.
cæspitosa, *Fst.* M.P.A.3. P. lævis, *Br.*
intermedia, *Buch.* P.A.M.2.
*acicularifolia, *Buch.* A.2.
*purpurea, *Kirk.* A.2.
colensoi, *Hk.f.* P.M.A.3.
lindsayi, *Hk.f.* P.M.A.3.
Festuca littoralis, *Br.* L.3.
scoparia, *Hk.f.* L.P.2.
*sp. F. duriuscula, *Hk.f.* non *Linn.* M.A.3.
Bromus arenarius, *Lab.* L.1.
Triticum multiflorum, *B. et S.* M.P. A.2.
*youngii, *Hk.f.* A.2.
squarrosum, *B. et S.* M.P.A.3.
*Gymnostichum gracile, *Hk.f.* P.1.

CRYPTOGAMIA.

FILICES. 34—107.

Niphobolus serpens, *Fst.* P.M.3.
Phymatodes pustulata, *Presl.* P.M.3.
billardieri, *Presl.* P.M.3.
Dyctimia lanceolata, *J. Smith.* P. ?
Gymnogramme rutæfolia, *Hk.* A.2.
leptophylla, *Des.* P.M.A.3.
*Platyloma rotundifolia, *J. Sm.* P. M.A.3.
Grammitis australis, *Swtz.* P.A.3.
Ctenopteris grammitides, *J. Sm.* P. A.2.
Goniopteris pennigera, *Fst.* P.M.3.
Lastrea velutina, *A. Rich.* P.3.
glabella, *J. Sm.* P.M.3.
Lastrea hispida, *J. Sm.* P.M.3.
Polystichum vestitum, *Presl.* P.M. A.3.
coriaceum, *Swtz.* P.M.2.
richardi, *Hk.* P.M.3.
cystostegia, *Hk.* A.2.
Arthropteris tenella, *J. Sm.* P.1.
Hypolepis tenuifolia, *Bern.* P.M.A.3.
millifolia, *Hk.* P.M.A.3.
distans, *Hk.* P.M.3.
rugulosa, *Lab.* P.M.A.2.
Cystopteris novæ-zealandiæ, *J.B.A.* C. fragilis, *Hk.f.* non *Bern.* P.M.A.3.
Cyathea smithii, *Hk.f.* P.M.2.

Cyathea dealbata, *Swz.* P.M.3.
Alsophila colensoi, *Hk.f.* P.M.A.2.
Dicksonia fibrosa, *Col.* P.M.3.
squarrosa, *Swz.* P.M.3.
lanata, *Col.* P.M.1.
Microlepia novæ-zealandiæ, *J. Sm.* P.M.3.
Dennstedtia dubia, *J. Sm.* P.M.1.
Lindsaya linearis, *Swz.* M.1.
Adiantum affine, *Willd.* P.M.3.
assimile, *Swz.* P.M.1.
fulvum, *Raoul.* P.M.2.
hispidulum, *Swz.* P.M.1.
Nothochlæna distans, *Br.* P.M.A.3.
Cheilanthes sieberi, *Kunze.* P.M.A.3.
Cheilanthes sieberi, *var.* deltoidea. C. tenuifolia, *Kirk*, non *Swz.* P.3.
Histopteris incisa, *Agardh.* P.M.A. 3.
Pteris tremula, *R. Br.* P.M. 1.
Ornithopteris esculenta, *Agdh.* P.M. A.L. 3.
scaberula, *Agdh.* P.M.A. 3.
Lomaria elongata, *Bl.* P.M. 1.
alpina, *Spreng.* P.M.A. 3.
banksii, *Hk.f.* P. 1.
*pumila, *Raoul.* P. 1.
nigra, *Colenso.* P.M. 1.
discolor, *Willd.* P.M. 3.
duplicata, *Potts.* P.M. 1.
rigida, *J. Sm.* L. dura, *Moore*, P.1.
membranacea, *Col.* P.M. 1.
rotundifolia, *Raoul.* L. fluviatilis, *Hk.f.* non *Spreng.* P.M. A. 3.
vulcanica, *Br.* P.M. 2.
minor, *Spreng.* P.M.A. 3.
procera, *Spreng.* P.M.A. 3.
Asplenium lucidum, *Fst.* L.P. 2.
obliquum, *Fst.* P. 1.
obtusatum, *Fst.* P. 2.
scleropium, *Homb.* M. 2.
trichomanes, *Linn.* P.A. 3.
flabellifolium, *Cav.* P.M.A. 3.
flaccidum, *Fst.* P.M. 3.
bulbiferum, *Fst.* P.M. 3.
appendiculatum, *Lab.* P.M. 2.
colensoi, *Moore.* P.M. 3.
hookerianum, *Col.* P.M. 3.
richardi, *Hk.f.* P.M. 2.
falcatum, *Lamk.* P.M. 1.
Gleichenia microphylla, *Br.* P.A. 1.
dicarpa, *Br.* P.M.A. 1.
alpina, *Br.* A.M. 1.
Gleichenia cunninghamii, *Hew.* P.A. M. 2.
*semivestita, *Lab.* P.A. 1.
Hymenophyllum polyanthos, *Swtz.* P.A.M.3.
rarum, *Br.* P.A.M.1.
flabellatum, *Br.* P.A.1.
demissum, *Swtz.* P.A.M.1.
scabrum, *Rich.* P.M.1.
crispatum, *Wall.* P.M.1.
pulcherrimum, *Col.* P.M.1.
dilatatum, *Swtz.* P.M.1.
villosum, *Col.* A.3.
montanum, *Kirk.* H. tunbridgense *var. (?).* A.2.
tunbridgense, *Sm.* P.M.A.3.
,, *var.* wilsoni. P.A.M.2.
ciliatum, *Swtz.* M.1.
multifidum, *Swtz.* P.M.A.2.
bivalve, *Swtz.* P.1.
armstrongii, *Hk.f.* A.3.
minimum, *Rich.* A.P.3.
æruginosum, *Carm.* P.1.
lyallii, *Hk.f.* P.1.
malingii, *Hk.* P.1.
Trichomanes reniforme, *Fst.* M.1.
humile, *Fst.* P.1.
venosum, *Br.* P.M.2.
elongatum, *Cunn.* P.M.1.
colensoi, *Hk.f.* P.M.1.
Schizæa dichotoma, *Swtz.* P.1.
Todea hymenophylloides, *Presl.* P. M.3.
superba, *Col.* P.M.2.
Ophioglossum gramineum, *Willd.* L. M.P.A.2.
costatum, *Br.* M.1.
*lusitanicum, *Willd.* P.M.A.3.
minimum, *J.B.A.* MS. M.1.
Botrychium dissectum, *Muhl.* P.M.1.
virginicum, *Willd.* M.P.A.3.

Lycopodiaceæ. 3—8.

Phylloglossum drummondii, *Kunze.* L.M.P.2.
Lycopodium selago, *Linn.* P.A.3.
varium, *Br.* A.P.1.
billardieri, *Spring.* A.P.2.
laterale, *Br.* A.1.
scariosum, *Fst.* A.1.
volubile, *Fst.* P.1.
Tmesipteris forsteri, *End.* P.1.

Marsileaceæ. 2—2.

Azolla rubra, *Br.* M.P.A.3.

Pilularia novæ-zealandiæ, *Kirk.* A.2.

ISOETACEÆ. 1—2.

Isoetes montana, *Kirk.* A.3.
*sp. Smaller than *I. montana;* spores not seen. A.1.

† MUSCI.

† None of the following are cultivated in the Christchurch Public Gardens.

Andrea acutifolia, *Wilson.*
nitida, *Wils.*
Sphagnum cuspidatum, *Ehr.*
novo-zelandicum, *Mitt.*
cymbifolium, *Dill.*
fimbriatum, *Wils.*
australe, *Mitt.*
Phascum apiculatum, *Wils.*
Gymnostomum calcareum, *Nees.*
tortile, *Schwæg.*
Weissia crispula, *Lud.*
flavipes, *Wils.*
Symblepharis perichætialis, *Wils.*
pumila, *Mitt.*
Fissidens adiantoides, *Hed.*
asplenioides, *Swtz.*
tenellus, *Wils.*
dealbatus, *Hk.f.*
rigidulus, *Wils.*
bryoides, *Hed.*
brevifolius, *Wils.*
Dicnemon calycinum, *Wils.*
Leucobryum candidum, *Hampe.*
Dicranum incanum, *Mitt.*
tasmanicum, *Hk.f.*
trichopodum, *Mitt.*
dicarpon, *Horn.*
,, *var.* spinosum.
robustum, *Wils.*
fasciatum, *Hed.*
billardieri, *Brid.*
setosum, *Wils.*
menziesii, *Taylor.*
Dicranodontium lineare, *Mitt.*
Campylopus introflexus, *Hed.*
appressifolius, *Mitt.*
clavatus, *Brown.*
torquatus, *Mitt.*
Trematodon suberectus, *Mitt.*
flexipes, *Mitt.*
Trichostomum lingulatum, *Wils.*
mutabile, *Bruch.*
elongatum, *Wils.*
setosum, *Wils.*
australe, *Mitt.*
Tortula papillosa, *Wils.*
muelleri, *Br.*
rubra, *Mitt.*
torquata, *Taylor.*
crispifolia, *Mitt.*
knightii, *Mitt.*
calycina, *Schwæg.*
Didymodon papillatus, *Wils.*
interruptus, *Mitt.*
erubescens, *Mitt.*
Desmatodon nervosus, *Schimper.*
Distichum capillaceum, *Schp.*
Ceratodon purpureus, *Bridel.*
Eucalypta australis, *Mitt.*
Hedwigia ciliata, *Ehr.*
Braunia humboldtii, *Schimp.*
Grimmia apocarpa, *Hed.*
pulvinata, *Smith.*
trichophylla, *Grev.*
basaltica, *Mitt.*
Racomitrium crispulum, *Wils.*
rupestre, *Wils.*
protensum, *Braun.*
symphiodon, *Mitt.*
lanuginosum, *Brid.*
Schlotheimia brownii, *Schwæg.*
Macromitrium longirostre, *Schwg.*
longipes, *Schwg.*
asperulum, *Mitt.*
gracile, *Schwg.*
hectori, *Mitt.*
microphyllum, *Grev.*
incurvifolium, *Schwg.* (?).
prorepens, *Schwg.*
erosulum, *Mitt.*
Orthotrichum luteum, *Mitt.*
Zygodon intermedius, *Schimper.*
brownii, *Schwg.*
reinwardtii, *Braun.*
menziesii, *Mitt.*
Leptostomum inclinans, *Br.*
gracile, *Br.*
macrocarpum, *Br.*
Orthodontium sulcatum, *Wils.*
Mielichoferia tenuiseta, *Mitt.*
Bryum pyriforme, *Hed.*
truncorum, *Bory.* B.
campylothecium, *Taylor.*
billardieri, *Schwg.*
rufescens, *Wils.*
wahlenbergii, *Schwg.*
crudum, *Schreber.*
eximium, *Mitt.*
lævigatum, *Wils.*

Bryum nutans, *Schreb.*
argenteum, *Linn.*
blandum, *Wils.*
bimum, *Schreb.*
torquescens, *Schimp.*
mucronatum, *Mitt.*
curvicollum, *Mitt.*
cæspiticium, *Linn.*
chrysoneuron, *Muell.*
annulatum, *Wils.*
pachytheca, *Muell.*
atropurpureum, *Web. et Mohr.*
Mnium rostratum, *Schwg.*
rhynchophorum, *Hk. et Harv.*
Meesia macrantha, *Mitt.*
Conastomum australe, *Swtz.*
pusillum, *Wils.*
Cryptopodium bartramioides, *Brid.*
Bartramia halleriana, *Hed.*
papillata, *Wils.*
patens, *Brid.*
crassinervia, *Mitt.*
remotifolia, *Wils.*
australis, *Mitt.*
tenuis, *Taylor.*
affinis, *Hk.*
pendula, *Hk.*
sieberi, *Mitt.*
comosa, *Mitt.*
divaricata, *Mitt.*
Fumaria hygrometrica, *Hed.*
glabra, *Taylor.*
Entosthodon gracilis, *Wils.*
Eremodon robustus, *Wils.*
octoblepharis, *Wils.*
purpurascens, *Wils.*
Polytrichum angustatum, *Hk.*
australe, *Wils.*
magellanicum, *Hed.*
dendroides, *Comm.*
tortile, *Swtz.*
alpinum, *Linn.*
juniperinum, *Hed.*
commune, *Linn.*
gracile, *Menz.*
Dawsonia superba, *Grev.*
Anœctangium compactum, *Schwg.*
Aulacopilum glaucum, *Wils.*
Leucodon implexus, *Kunze.*
nitidus, *Wils.*
Leptodon smithii, *Bridel.*
Cladomnion ericoides, *Wils.*
sciuroides, *Wils.*

Meteorium molle, *Wils.*
cuspidiferum, *Taylor.*
flexicaule, *Wils.*
Cyrtopus setosus, *Brid.*
Mesotus celatus, *Mitt.*
Phyllogonium elegans, *Wils.*
Neckera pennata, *Hedwig.*
lævigata, *Wils.*
Trachyloma planifolia, *Brid.*
Isothecium sulcatum, *Wils.*
pandum, *Wils.*
arbusculum, *Wils.*
ramulosum, *Mitt.*
angustatum, *Mitt.*
gracile, *Wils.*
menziesii, *Wils.*
kerrii, *Mitt.*
spininervium, *Wils.*
marginatum, *Wils.*
comosum, *Wils.*
comatum, *Muell.*
Hypnum furfurosum, *Wils.*
fulvastrum, *Mitt.*
sparsum, *Wils.*
læviusculum, *Mitt.*
uncinatum, *Hed.*
brachiatum, *Mitt.*
hispidum, *Wils.*
tenuirostre, *Hk.*
crassiusculum, *Brid.*
jolliffii, *Mitt.*
pubescens, *Wils.*
leptorhynchum, *Brid.*
chrysogaster, *Muell.*
cupressiforme, *Linn.*
pulchellum. *Dickson.*
muriculatum, *Wils.*
austrinum, *Wils.*
remotifolium, *Grev.*
tenuifolium, *Hed.*
aristatum, *Wils.*
rutabulum, *Linn.*
paradoxum, *Wils.*
plumosum, *Swtz.*
relaxum, *Wils.*
decussatum, *Wils.*
aciculare, *Lab.*
cochlearifolium, *Schwg.*
clandestinum, *Wils.*
chlamydophyllum, *Wils.*
inflatum, *Wils.*
divulsum, *Wils.*
extenuatum, *Brid.*

Hypnum denticulatum, *Linn.*
Omalia pulchella, *Wils.*
Rhizogonium distichum, *Brid.*
novæ-hollandiæ, *Brid.*
bifarium, *Schimper.*
mnioides, *Wils.*
subbasilare, *Schimp.*
Hymenodon piliferus, *Wils.*
Hypopterygium filiculæforme, *Brid.*
viridulum, *Mitt.*
novæ-zealandiæ, *C. Muell.*
tamariscinum, *Sull.*
ciliatum, *Brid.*
concinnum, *Brid.*
struthiopteris, *Brid.*
Cyathophorum pennatum, *Brid.*
Calomnion lætum, *Wils.*
Racopilum strumiferum, *Muell.*
Hookeria tenella, *Wils.*
rotundifolia, *Wils.*
pulchella, *Wils.*
amblyophylla, *Wils.*
flexuosa, *Mitt.*
microcarpa, *Wils.*
quadrifaria, *Smth.*
nigella, *Wils.*
Hookeria cristata, *Arnott.*
flexicollis, *Mitt.*
Daltonia nervosa, *Wils.*

Hepaticæ.

Gymnomitrium concinnatum, *Corda.*
Jungermannia monodon, *Taylor.*
colorata, *Lehm.*
flexicaulis, *Nees.*
rotata, *Taylor.*
perigonalis, *Tay.*
Trigonanthus dentata, (*Radd.*) *Mitt.*
Chandonanthus squarrosa, (*Hk.*) *Mitt.*
Temnonea pulchella, *Mitt.*
Plagiochila conjugata, *Lindb.*
pleurota, *Tay.*
stephensoniana, *Mitt.*
gigantea, *Lindb.*
arbuscula, *Lehm.*
fasciculata, *Lindb.*
dicksoni, *Tayl.*
microdictyon, *Mitt.*
deltoidea, *Lindb.*
annotina, *Lindb.*
incurvifolia, *Tayl.*
lyallii, *Mitt.*
Lophocolea pallida, *Mitt.*
heterophylloides, *Nees.*
Lophocolea triacantha, *Tayl.*
novæ-zealandiæ, *Nees.*
lenta, *Tayl.*
muricata, *Nees.*
Scapania vertebralis, *Gott.*
Gottschea lehmaniana, *Lindb.*
balfouriana, *Tayl.*
repleta, *Tayl.*
unguicularis, *Tayl.*
appendiculata, *Nees.*
nobilis, *Nees.*
pinnatifolia, *Nees.*
tuloides, *Tayl.*
Chiloscyphus menziesii, *Mitt.*
billardieri, *Nees.*
sinuosus, *Nees.*
polycladus, *Mitt.*
coalitus, *Nees.*
odoratus, *Mitt.*
Adelanthus falcatus, *Mitt.*
Tylimanthus saccatus, *Mitt.*
Lepidozia microphylla, *Lindb.*
capilligera, *Lindb.*
prænitens, *Lehm.*
lævifolia, *Tayl.*
pendulina, *Lindb.*
spinosissima, *Mitt.*
lindenbergii, *Gotts.*
capillaris, *Lindb.*
Mastigobryum anisostomum, *Lindb.*
novæ-hollandiæ, *Nees.*
novæ-zealandiæ, *Mitt.*
involutum, *Lindb.*
Isotachis lyallii, *Mitt.*
Trichocolea tomentilla, *Nees.*
lanata, *Nees.*
Sendtnera flagellifera, *Nees.*
Polyotus claviger, *Gotts.*
magellanica, *Gotts.*
Radula buccinifera, *Tayl.*
physoloba, *Montagne.*
complanata, *Dumort.*
marginata, *Tayl.*
Madotheca stangeri, *Gotts.*
Lejeunia pulchella, *Mitt.*
scutellata, *Mitt.*
anguiformis, *Tayl.*
papillata, *Mitt.*
rufescens, *Lindb.*
latitans, *Hk.j. et Tayl.*
nudipes, *Tayl.*
thymifolia, *Nees.*
tumida, *Mitt.*

Frullania cornigera, *Mitt.*
squarrosula, *Tayl.*
pycnantha, *Hk.f. et Tayl.*
cranialis, *Tayl.*
pentapleura, *Tayl.*
ptychantha, *Mont.*
aterrima, *Tayl.*
congesta, *Tayl.*
Fossombronia pusilla, *Nees.*
Noteroclada porphyrorhiza, *Mitt.*
Zoopsis argentea, *Tayl.*
Podomitrium phyllanthus, *Mitt.*
Symphogynia flabellata, *Mont.*
leptopoda, *Tayl.*
hymenophyllum, *Mont.*
subsimplex, *Mitt.*
Metzgeria furcata, *Nees.*
Aneura alterniloba, *Tayl.*
palmata, *Nees.*
multifida, *Dumort.*
Marchantia tabularis, *Nees.*
nitida, *Lindb.*
foliacea, *Mitt.*
Dumortiera hirsuta, *Nees.*
Reboulia hemisphærica, *Radd.*
Fimbriaria drummondii, *Tayl.*
Riccia fluitans, *Linn.*
Anthoceros lævis, *Linn.*
giganteus, *Lindb.*
colensoi, *Mitt.*

CHARACEÆ.

Nitella hyalina, *Agardh.*
hookeri, *Braun.*
Chara fœtida, *Braun.*
contraria, *Braun.*

LICHENES.

Collema flaccidum, *Acharius.*
nigrescens, *Ach.*
Leptogium tremelloides, *Fries.*
Sphærophorion compressus, *Ach.*
coralloides, *Pers.*
tenerum, *Laur.*
Cladonia pyxidata, *Fries.*
fimbriata, *Hoffm.*
gracilis, *Hoffm.*
cariosa, *Flk.*
furcata, *Hoffm.*
rangiferina, *Hoffm.*
capitellata, *Lab.*
aggregata, *Esch.*
retipora, *Flrk.*
cornucopiodes, *Fries.*
Stereocaulon ramulosum, *Ach.*
Stereocaulon corticulatum, *Nyl.*
Usnea barbata, *Fries.*
melaxantha, *Ach.*
Alectoria ochroleuca, *Nyl.*
Ramalina calicaris, *Fries.*
Nephroma australe, *Rich.*
schizocarpum, *Nyl.*
lævigatum, *Ach.*
lyallii, *Bab.*
Peltigera rufescens, *Hoffm.*
polydactyla, *Hoffm.*
Sticta argyracea, *Del.*
hookeri, *Bab.*
crocata, *Ach.*
carpoloma, *Del.*
filicina, *Ach.*
damæcornis, *Ach.*
variabilis, *Ach.*
orygmæa, *Ach.*
aurata, *Ach.*
fossulata, *Dufour.*
freycinetii, *Del.*
Ricasolia coriacea, *Nyl.*
glomulifera, *De Not.*
Parmelia caperata, *Ach.*
perlata, *Ach.*
saxatilis, *Ach.*
conspersa, *Ach.*
olivacea, *Ach.*
physodes, *Ach.*
pertusa, *Schær.*
flavicans, *DC.*
parietina, *Ach.*
speciosa, *Ach.*
Psoroma subpruinosum, *Nylander.*
hypnorum, *Fries.*
sphinctrinum, *Nyl.*
Pannaria rubiginosa, *Del.*
triptophylla, *Nyl.*
Squamaria gelida, *Decaisne.*
Placodium murorum, *DC.*
Lecanora cerina, *Ach.*
aurantiaca, *Ach.*
vitellina, *Ach.*
parella, *Ach.*
tartarea, *Ach.*
glaucoma, *Ach.*
varia, *Ach.*
atra, *Ach.*
punicea, *Ach.*
Urceolaria scruposa, *Ach.*
Thelotrema lepadinum, *Ach.*
Cœnogonium linkii, *Ehrb.*
Lecidea cupularis, *Ach.*

Lecidea parvifolia, *Pers.*
cinnabarina, *Sommerfeldt.*
vernalis, *Ach.*
decolorans, *Flk.*
coarctata, *Nyl.*
tuberculosa, *Fée.*
decipiens, *Ach.*
mamillaris, *Dufour.*
vesicularis, *Ach.*
parasema, *Ach.*
contigua, *Fries.*
geographica, *Schærer.*
pachycarpa, *Dufour.*
Graphis scripta, *Ach.*
Opegrapha varia, *Pers.*
Stigmatidium crassum, *Duby.*
Arthonia lurida, *Ach.*
conspicua, *Nyl.*
Verrucaria umbrina, *Wahl.*
maura, *Wahl.*
epidermidis, *Ach.*
nitida, *Schrader.*
glabrata, *Ach.*
moniliformis, *Knight.*

FUNGI.

Agaricus phalloides, *Fries.*
exstructus, *Berk.*
brevipes, *Bull.*
cartilagineus, *Bull.*
carneus, *Bull.*
colensoi, *Berk.*
novæ-zealandiæ, *Berk.*
erebius, *Fries.*
adiposus, *Fries.*
sapineus, *Fries.*
arvensis, *Schæff.*
campestris, *Linn.*
semiglobatus, *Bth.*
fascicularis, *Huds.*
strophosus, *Fries.*
muscarius, *Linn.*
auratus, *With.*
appendiculatus, *Bull.*
Coprinus fimetarius, *Fries.*
Hygrophorus cyaneus, *Fries.*
Lentinus novæ-zealandiæ, *Bk.*
Panus maculatus, *Bk.*
Schizophyllum commune, *Fries.*
Polyporus arcularius, *Fries.*
lucidus, *Fries.*
adustus, *Fries.*
igniarius, *Fries.*
scruposus, *Fries.*
Polyporus plebeius, *Bk.*
borealis, *Fries.*
versicolor, *Fries.*
sanguineus, *Fries.*
Favolus intestinalis, *Bk.*
Irpex brevis, *Bk.*
Stereum lobatum, *Kunze.*
vellereum, *Bk.*
hirsutum, *Fries.*
rugosum, *Fries.*
Corticium polygonium, *Fries.*
ochroleucum, *Fries.*
Clavaria lutea, *Vitt.*
flaccida, *Fries.*
Pistillaria ovata, *Fries.*
Hirneola auricula-judæ, *Bk.*
hispidula, *Bk.*
Aseroe rubra, *Lab.*
hookeri, *Bk.*
Ileodictyon cibarium, *Tulas.*
gracile, *Bk.*
Secotium erythrocephalum, *Tul.*
lilacensis, *Bk.*
Geaster fimbriatus, *Fries.*
Bovista brunnea, *Bk.*
Lycoperdon giganteum, *Bth.*
cælatum, *Fries.*
fragilis, *Vitt.*
pyriforme, *Schæf.*
Æthalium septicum, *Fries.*
Cyathus novæ-zealandiæ, *Bk.*
Nidularia campanulata.
Crucibulum vulgare, *Tulas.*
Asteroma dilatata, *Bk.*
Puccinea graminis, *Persoon.*
compacta, *Bk.*
Uredo antarctica, *Bk.*
Ustilago segetum, *Link.*
candollei, *Tulas.*
endotricha, *Bk.*
bullata, *Bk.*
Stilbum lateritium, *Bk.*
Cladosporium herbarum, *Link.*
Sepedonium chrysospermum, *Fries.*
Morchella esculenta.
Leotia lubrica, *Pers.*
Geoglossum hirsutum, *Pers.*
Peziza miltina, *Bk.*
stercorea, *Fries.*
calycina, *Fries.*
Asterina fragilissima, *Bk.*
Cordiceps sinclairii, *Bk.*
Hypocrea gelatinosa, *Fries.*

Hypoxylon concentricum, *Fries.*
Dothidea ribesia, *Fries.*
Sphæria fragilis, *Bk.*
pullularis, *Bk.*
herbarum, *Pers.*
lindsayi, *Currey.*
Chætomium elatum, *Kunze.*
Meliola amphitricha, *Fries.*
Antennaria robinsonii, *Mont.*
Oidium tuckeri.

Algæ.

Sargassum longifolium, *Agardh.*
plumosum, *Rich.*
raoulii, *Harvey.*
sinclairii, *Harv.*
bacciferum, *Agdh.*
Turbinaria ornata, *Agdh.*
Carpophyllum phyllanthus, *Harv.*
maschalocarpus, *Harv.*
Marginaria boryana, *Rich.*
Phyllospora comosa, *Agdh.*
Cystophora torulosa, *Agdh.*
retorta, *Agdh.*
retroflexa, *Agdh.*
dissecta, *Agdh.*
Landsboroughia quercifolia, *Harv.*
Fucodium gladiatus, *Agdh.*
chondrophyllus, *Agdh.*
Hormosira billardieri, *Mont.*
Splachnidium rugosum, *Grev.*
Notheia anomala, *Bail. et Harv.*
D'Urvillæa utilis, *Bory.*
Desmarestia ligulata, *Lam.*
Macrocystis pyrifera, *Agdh.*
Ecklonia radiata, *Agdh.*
Zonaria interrupta, *Agdh.*
turneriana, *Agdh.*
velutina, *Harv.*
Dictyota kunthii, *Agdh.*
Adenocystis lessonii, *Harv.*
Chordaria sordida, *Bory.*
Sphacelaria paniculata, *Suhr.*
funicularis, *Mont.*
Ectocarpus granulosus, *Agdh.*
siliculosus, *Lyngbye.*
Rytiphlœa delicatula, *Harv.*
Rhodomela gaimardii, *Ag.*
glomerulata, *Mont.*
Bostrychia distans, *Harv.*
Polysiphonia implexa, *Harv.*
macra, *Harv.*
rudis, *Harv.*
abscissa, *Harv.*
Polysiphonia variabilis, *Harv.*
brodiæi, *Grev.*
comoides, *Harv.*
australis, *Agdh.*
decipiens, *Mont.*
cancellata, *Harv.*
Dasya collabens, *Hk.f.*
Polyzonia cuneifolia, *Mont.*
harveyana, *Decais.*
Champia novæ-zealandiæ, *Harv.*
parvula, *Harvey.*
Laurencia virgata, *Agdh.*
papillosa, *Grev.*
Cladhymenia oblongifolia, *Harv.*
Carpomitra cabreræ, *Kuetz.*
Delisea elegans, *Lamouroux.*
Amphiroa wardii, *Harvey.*
Corallina armata, *Hk.f.*
Jania cuvierii, *Decaisne.*
micrarthrodia, *Lamour.*
novæ-zealandiæ, *Harv.*
Delesseria hookeri, *Lyall.*
quercifolia, *Bory.*
Nitophallum variolosum, *Harv.*
Gelidium corneum, *Lam.*
Rhodymenia lanceolata, *Harv.*
Dasyphlœa insignis, *Mont.*
Plocamium angustum, *Hk.f.*
coccineum, *Lyng.*
Stenogramme interrupta, *Mont.*
Callophyllis hombroniana, *Kuetz.*
acanthocarpa, *Harv.*
erosa, *Hk.f. et Harv.*
Gigartina pistillata, *Gmelin.*
alveata, *Agdh.*
ancistroclada, *Mont.*
radula, *Agdh.*
Iridæa micans, *Bory.*
Epymenia acuta, *Harv.*
obtusa, *Kuetz.*
Chylocladia secunda, *Hk.f.*
Nemastoma prolifera, *Harv.*
Dumontia filiformis, *Grev.*
pusilla, *Mont.*
Ceramium diaphanum, *Roth.*
rubrum, *Agdh.*
cancellatum, *Agdh.*
Ptilota pellucida, *Harv.*
Griffithsia setacea, *Agdh.*
antarctica, *Hk.f.*
Ballia callitricha, *Mont.*
hirtum, *Hk.f. et Harv.*
Codium adhærens, *Agdh.*

Porphyra laciniata, *Agdh.*
Ulva latissima, *Linn.*
crispa, *Light.*
Enteromorpha compressa, *Grev.*
Batrachospermum moniliforme, *Roth.*
Cladophora lyallii, *Harv.*
Cladophora gracilis, *Griffiths.*
colensoi, *Harv.*
Conferva darwinii, *Kuets.*
valida, *Harv.*
Tyndaridea anomala, *Ralfs.*
Nostoc verrucosum, *Vauch.*

NATURALIZED PLANTS.

A list of naturalized plants will be found in the volume of Transactions for 1871, page 284. The following have been introduced since that date :—

Ranunculus arvensis, *L.*
pratensis, *L.*
sceleratus, *L.*
Alyssum calycinum, *L.*
Silene inflata, *Sm.*
armeria, *L.*
italica, *Pers.*
nutans, *L.*
orientalis, *L.*
Coronopus didyma.
Stellaria graminea, *L.*
Polycarpon tetraphyllum, *L.*
Spergula pilifera, *Hort.*
Malva campestris, *L.*
sylvestris.
Eucalyptus globulus.
Linum angustifolim, *Sm.*
marginale, *Cunn.*
Trifolium maritimum, *L.*
arvense, *L.*
maculatum, *Hort.*
ochroleucum, *Sm.*
filiforme, *Huds.*
Melilotus officinalis, *L.*
Vicia tetrasperma, *Koch.*
Lathyrus sylvaticus, *L.*
grandiflorus, *Hort.*
Acacia decurrens, *Willd.*
Potentilla reptans, *L.*
Œnothera biennis, *L.*
grandiflora.
Helianthus annuus, *L.*
Helminthis echioides, *St.*
Cichorium intybus, *L.*
Onopordon acanthium, *L.*
Picris hieracioides, *L.*
Anthemis arvensis, *C.*
Chrysanthemum coronarium.
Centaurea nigra, *L.*
cyanus, *L.*
Echium violaceum, *L.*
Anchusa italica, *L.*
Convolvulus arvensis, *L.*
Lobelia erinus.
Verbascum nigrum, *L.*
blatteria, *Sm.*
Lamium amplexicaule, *L.*
maculatum, *L.*
purpureum, *L.*
Mentha arvensis, *Sm.*
Teucrium scorodonia, *L.*
Anagallis grandiflora, *Hort.*
Prunella grandiflora, *Hort.*
Polygonum dryandri.
Rumex palustris, *Sm.*
Chenopodium ambrosioides.
Euphorbia lathyrus, *L.*
Vinca major, *L.*
Salix fragilis, *L.*
Betula alba, *L.*
Quercus cerris, *L.*
pedunculata, *L.*
Acer pseudo-platanus, *L.*
Cyperus tenellus, *L.*
Pinus pinaster, *Sol.*
Kœleria cristata, *Pers.*
Alopecurus geniculatus, *L.*
Maizilla stolonifera, *End.*
Cinna mexicana.
Sporobolus elongatus, *Br.*
Lagurus ovatus, *L.*
Cynodon dactylon, *Pers.*
Panicum germanicum, *L.*
Poa compressa, *L.*
Festuca loliacea, *Huds.*
Triticum junceum, *L.*

ART. L.—*Notice of the Occurrence of* Liparophyllum gunnii, *Lob., in New Zealand.* By D. PETRIE, M.A.

[*Read before the Otago Institute, 10th February,* 1880.]

THE following is the generic character of *Liparophyllum*, translated from Hooker's Flora of Tasmania:—

Calyx deeply 5-fid. Corolla subrotate, limb patent 5-partite, lobes hairless, disc even thick, margins undulated. Stamens five, filaments short; hypogynous glands none. Ovary one-celled, placentas two, parietal, ovules numerous. Fruit indehiscent, subbaccate. Seeds very numerous, suborbicular, compressed (my specimens immature); testæ rather hard and thick.

A very small marshy herb; rhizome creeping, giving off stout fibres; branches ascending, short, leafy; leaves linear-elongate, fleshy, somewhat sheathing at the base. Peduncles terminal, solitary, short, one-flowered; flowers white.

The specific description of *L. gunnii* is given as follows:—A very small herb, 1–2 inches high, resembling a dwarf state of *Claytonia australasica*. Rhizomes long, cylindric, branching, sending down long, very thick, simple fibres; stems short; leaves linear, one inch long, $\frac{1}{6}$ broad, subacute, fleshy, quite entire. Peduncle shorter than the leaves, terminal, erect, one-flowered. Flowers about $\frac{1}{3}$-inch in diameter. Calyx lobes five, acute. Corolla, short; lobes five, oblong, blunt, with a thick fleshy disc, and undulated, broad, membranous margins. Fruit globose; seeds numerous, compressed, nearly orbicular, bright yellow.

This remarkable plant belongs to the natural order *Gentianeæ*, and is extremely unlike the other New Zealand representatives of the same order. It is a member of the tribe *Menyantheæ*, Griesbach. It occurs abundantly in marshy ground at the head of Paterson's Inlet, Stewart Island, and more sparingly in similar situations at Port Pegasus. In Tasmania it grows in wet sandy soil on the margin of alpine lakes, but in Stewart Island its habitat is little above sea-level. I am indebted to Thomas Kirk, Esq., F.L.S., of Wellington, for the first hint that the plant was *Liparophyllum gunnii*. It has not, so far as I know, been gathered here in flower, or by any one else than Mr. Thomson and myself. The other characters agree so well with Hooker's description, that I entertain no doubt as to the accuracy of Mr. Kirk's identification.

ART. LI.—*Notice of the Occurrence of a Species of* Hemiphues *in New Zealand.* By D. PETRIE, M.A.

[*Read before the Otago Institute, 10th February*, 1880.]

THE following is the generic character of *Hemiphues*, Hook. fil., translated from Hooker's Flora of Tasmania :—

Fruit ovate, oblique, swollen, one-celled, the mericarps cemented together, or one wholly suppressed, crowned by five unequal, deciduous, lobes of the calyx limb, without vittæ, five-ribbed, the ribs inconspicuous and placed opposite the calyx lobes. Petals five linear, sometimes none ? Stamens five. Stylopodia connate, divided into two short erect styles.

Alpine herbs, densely cæspitose, scapigerous, more or less pilose or woolly ; the leaves all radical, petiolate, spathulate, quite entire or toothed ; scapes short, stout ; the umbel simple ; the leaves of the involucre adhering and forming a many-toothed cup ; flowers sessile, inconspicuous.

The plant which I refer to this genus was found in Stewart Island, in low boggy situations, in the open land at the head of Paterson's Inlet, and in open moist situations ranging in altitude from sea-level to 1,500 feet, to the west of Port Pegasus. The character of the habitat agrees entirely with that of its Tasmanian congener, *Hemiphues bellidioides*, Hook. fil. The Tasmanian species flowers in October and November, and the New Zealand one probably flowers in November and December, as the specimens gathered by Mr. Thomson and myself, in the middle of January, had the fruit ripe and ready to fall off.

We had the good fortune to meet with one imperfect and withered flower, which exhibited on dissection anomalous characters allied to the Umbelliferæ. The habit and general appearance of the plant agree very closely with the generic description, the only points of divergence being that the leaves are not radical but arranged along the stem, while the involucral leaves are not adherent except at the base. In Tasmania, *H. bellidioides* occurs at an elevation of 4,000 feet, but the Stewart Island species descends to sea-level, as might be expected from the difference in latitude. I propose to designate this highly interesting addition to the flora of New Zealand, *Hemiphues novæ-zealandiæ*. The following description is necessarily very incomplete, as the plants were long past flowering when gathered :—

HEMIPHUES NOVÆ-ZEALANDIÆ, n. s.

A densely tufted prostrate perennial herb with short very slender stems. Leaves alternate exstipulate spathulate rather fleshy, glabrous save for a few hairs on the margin at and near the tips, base sheathing silky. Scapes axillary, ¼-inch high, with four or five oblong involucral leaves enclosing five or fewer flowers. Stylopodia connate conical, at length divided into

two tapering styles. Fruit minute ovate turgid, somewhat compressed, one-celled, ribs indistinct.

I think there can be little doubt about including the plant just described in the genus *Hemiphues.* Certainty about its position cannot of course be attained until flowering specimens are examined. The fruit is minute, and not easy to dissect so as to show its structure plainly. Still I am satisfied that it is one-celled.

Whatever surprise may be felt at the discovery of a *Hemiphues* in Stewart Island, should be greatly lessened by the fact that another Tasmanian alpine plant, viz., *Liparophyllum gunnii*, grows abundantly side by side with it.

By way of postcript I may add that I have another apparently umbelliferous plant, of a most anomalous character, gathered in the same localities as *Hemiphues novæ-zealandiæ*, which may prove another species of that genus. It has a very different general appearance, but the involucral leaves and one-celled fruit closely resemble *Hemiphues.* The specimens are long past flower, and the fruits, from which the stylopodia have become detached, have fallen off nearly all my specimens. As I cannot indicate the genus, or even the natural order (for it might be a composite plant) with any certainty from the few poor specimens in my possession, I shall not now attempt any partial description of it.

Art. LII.—*Description of a new Species of* Ehrharta. By D. Petrie, M.A.

Plate X.

[*Read before the Otago Institute, 10th February,* 1880.]

Ehrharta thomsoni, n.s.

A short tufted grass; culm flattened, branched, 2–5 inches long. Leaves distichous, glabrous, flat or concave, about ½ inch long, deeply and closely grooved; sheaths imbricating, broad, pale, ligule none.

Panicle contracted, erect, of 2–4 spikelets, on short slender stalks. Empty glumes, four; lower pair short, broad, obtuse, nearly equal; upper pair thrice the length of the lower, lanceolate, laterally compressed, nearly equal, silky at the base, 3–5-nerved, the nerves coalescing to form an acute awn-like tip, scabrid on the keel. Flowering glume shorter, three-nerved, bluntly and shortly acuminate. Palea linear rather coriaceous. Scales large, broadly acute, entire. Grain enclosed in the flowering glume. Stamens and styles not seen.

EHRHARTA THOMSONII, Petrie

J. Buchanan, del. et lith.

Habitat.—Port Pegasus, Stewart Island, on wet open ground, ranging from 100 to 1500 feet in elevation. Named in honour of G. M. Thomson, Esq., of the Dunedin High School, who discovered it along with myself. The only other New Zealand species of *Ehrharta* is an alpine plant from the Tararua Range, Wellington. This grass possesses, I should say, no economic value.

DESCRIPTION OF PLATE X.

Fig. 1. *Ehrharta thomsoni*, Petrie. Nat. size.
2. Spikelet.
3. Upper pair of empty glumes and floret.
4. Floret.
5,5′ Nervation of lower pair of empty glumes.
6,6′ „ upper „ „
7. „ flowering glume.
8. „ palea.
9,9′ Scales.
10. Grain.

ART. LIII.—*Notes on the Growth of certain Trees on Scoria Soil near Mount Eden, Auckland.* By T. B. GILLIES, a Judge of the Supreme Court of New Zealand.

[*Read before the Auckland Institute, 30th June*, 1879.]

IN autumn, 1866, I planted a variety of trees on a piece of scoria land at the foot of Mount Eden, where I had just built my house, and have now (February, 1879) carefully measured them with the following results. The land was wild scoria land, the surface covered with scoria boulders, the partial disintegration of which had formed soil below, in which were also imbedded scoria boulders. At a greater depth were masses of scoria rock and ash partially decomposed and in many places forming rocky cavities. The surface vegetation was grass and fern. The young trees when planted were from one to two feet high, probably two to three-year-old seedlings. Oaks and other deciduous trees did not thrive, and ultimately died off, except the upright poplar, one badly-grown elm, and the weeping willow. Peach trees grow rapidly and fruit well for a few years (about seven), and then cease to bear. Apple trees grow well and fruit freely for a few years, and then die off from a sort of dry-rot at the roots. Plums, apricots, and cherries do badly in this soil. It will be seen from the annexed table that coniferous trees grow wonderfully in such soil, especially *P. insignis* and *radiata*, as also *Cupressus macrocarpa*, *Taxodium sempervirens*,

and *Araucaria excelsa.* The following are the results of barely thirteen years' growth :—

Tree.	Height. Ft.	in.	Girth. Ft.	in.	
Pinus insignis	58	0	7	6	These are very difficult to distinguish until they come, and even then *insignis* and *insignis* var. are difficult, their cones being so variable. All lopped to 6ft. from ground.
"	59	0	6	2	
" var.	44	6	5	10	
"	54	0	6	6	
P. radiata	40	0	6	0	
"	49	0	6	6	
P. muricata	32	0	4	6	Lopped to 6ft.
"	35	0	3	7	This tree grown amongst *P. pineaster* may account for its greater height and less girth. Lopped to 6ft.
"	27	0	4	6	Lopped to 4ft.
"	22	0	4	0	Not lopped.
P. canariensis	32	0	2	10	"
P. pineaster	30ft to 35ft.		4	4	A large number of them, all lopped to 6ft. from ground.
Pinus pinea (Stone Pine) ..	27	0	3	11	Lopped 5ft.
"	20	0	4	3	Not lopped.
P. sylvestris (Scotch Fir) ..	19	0	1	9	Both these are probably slightly crippled from too close proximity to *insignis* and *radiata.*
"	21	6	2	6	
P. longifolia	21	0	3	6	(Taken 30th June).
P. pumilo	4	6	—		Branching from ground.
"	5	0	—		
Silver Tree (*Leucodendron argenteum*)	27	0	4	3	Cut down.
" "	29	0	4	4	
Cupressus macrocarpa ..	29	0	7	0	Lopped to 6ft. from ground.
"	39	0	7	2	"
C. torulosa	22	0	—		Dense foliage to the ground.
C. lawsoniana	21	0	—		"
C. sempervirens (spreading) ..	31	0	2	8	
"	31	0	3	2	
Abies excelsa (Spruce) ..	25	0	1	6	Probably stunted from proximity to *P. insignis.*
Cedrus deodara	21	0	2	0	Leader twice broken off. Lopped 5ft.
C. atlantica	20	0	1	8	Very graceful trees.
"	17	0	1	7	
C. libani	13	0	1	4	
Araucaria excelsa (Norfolk Is. Pine)	35	0	3	1	Lopped to 6ft. high.
"	35	0	2	5	Not lopped, but a little more exposed.
Sequoia gigantea (*Wellingtonia*)	17	6	3	0	Slow growing at first, but making a thick butt.
"	23	0	3	10	
Taxodium sempervirens (Redwood)	28	6	3	6	Lopped to 6ft. high.
Ficus lucida	23	0	2	8	
Podocarpus totara (Totara) ..	15	0	1	4	
Weeping-willow (cutting planted autumn, 186—)	42	6	6	4	Taken 30th June, 1879.
Upright Poplar (10ft. high when planted)	40	6	4	3	Several of them.

My experience shows me that lopping the lower branches promotes growth in height, and, by allowing a free circulation of air from below, checks the ravages of red spider, thrip, and other insect pests.

Art. LIV.—*A Description of a few new Plants from our New Zealand Forests, with dried Specimens of the same.* By W. Colenso, F.L.S.

[Read before the Hawke's Bay Philosophical Institute, 13th October, 1879.]

During the last few years I have again turned my attention in spare time to the elucidating a little more of the still unknown botany of our adopted country; being as strong a believer as ever in the great peculiarities and narrow areas of not a few plants of our local Floras. And, from among several plants which I have detected, which have pleased me, I now bring you the following—all, I believe, being new species and hitherto undescribed, if not totally unknown to science. Some of them, I think, will interest you, particularly the *Clematis*, one of the two species of *Metrosideros*, and the three ferns. But, alas! between the most carefully prepared dried specimens and living plants—in all their glory and beauty—there is "a great gulph" of difference:—

Clematis parkinsoniana.

A diffuse slender climber; branches striated.

Leaves 3-foliolate, submembranaceous, various in size and outline, mostly (1) ovate acute, mucronate, entire, 1½ inches long, 7–8 lines broad, (2) sometimes deeply serrated and incised, having 1–4 incisions near apex, (3) sometimes cordate acuminate, 2 inches long, with 6–8 very large and irregular serratures or incisions, and (4) sometimes (rarely) broadly elliptic, almost orbicular, entire, and very obtuse; obscurely trinerved, nerves red; both surfaces well covered with adpressed golden-yellow shining hairs; *veins* numerous, yellow-red and semi-translucent, very finely reticulated—compound anastomosing having free veinlets terminating in areoles, as obtains in some ferns—(*e.g.*, *Polypodium membranaceum* and our own *P. billardieri*); common petiole 3 inches long, petiolules 8–10 lines long; young branches, petioles, peduncles, and pedicels densely villous with yellowish-brown spreading woolly hairs. *Flowers* numerous, diameter 9–10 lines, disposed in long loose axillary panicles 4 inches long; *sepals* (male), six, yellow (brass colour), oblong-lanceolate, very obtuse or retuse, 4 lines long, obscurely 3–5 nerved, nerves branching, very woolly on the outside, the silky wool extending far beyond margins and apex, giving a subciliated appearance; *anthers* elliptic, obtuse, pinkish; *filaments* linear lanceolate, of various lengths, but much shorter than sepals, not very numerous, under thirty, often remaining after the sepals have fallen. *Peduncles* opposite, springing from main rhachis, 1–2 inches long, and about 1 inch apart, generally trichotomously bearing three flowers on pedicels 5–8 lines long, the central pedicel always the longest; peduncles and pedicels each having a pair of oblong obtuse connate bracts at their bases, those of the pedicels being the longest, thinnest, and simply veined.

A species having affinity with *C. parviflora*, A. Cunn., though very distinct.

Hab.—On the banks of the River Mangatawhainui (head of the River Manawatu), "Forty-mile bush," 1878, and again, 1879; where it forms dense bushes with *Rubus cissoides*, climbing tolerably high, 14–16 feet, and presenting a glorious mass of yellow blossoms. Its flowers, however, are very fugacious, so much so that it is difficult to obtain good specimens, the mere gathering causing them to fall; hermaphrodite flowers, though carefully sought, were not seen.

I have very great pleasure in naming this graceful plant after *our* earliest botanical draughtsman, SYDNEY PARKINSON, who accompanied Sir Joseph Banks and Captain Cook on their first voyage of discovery to New Zealand. *Manibus Parkinsonibus sacrum.**

METROSIDEROS PENDENS.

A climbing plant with reddish rugged bark, having stems round or obtusely and irregularly furrowed and angled or compressed, emitting rootlets like ivy, and bearing many pendulous leafy branches.

Leaves decussate and distichous, shortly petiolate, ovate acute, 7–9 lines long, 3–5 lines broad, with occasionally a pair nearly orbicular, triplinerved or sub-quintuplinerved, very pilose on both sides, thickly punctate, somewhat concave and imbricate, margins revolute, dark-green above and pale or yellowish-green below, sub-membranaceous, old leaves rather dry with obscure veins, young leaves and branchlets very light-coloured with scarcely a tinge of green at first; ultimate branches long, straight, always simple drooping, 12–18 inches long, densely villous, hairs patent. *Flowers* pendulous, white, small, 2 lines long, 8–16 together in a thyssoid panicle, mostly trichotomous, and always terminal; *calyx* gracefully infundibuliform, nearly 2 lines long, more than twice as long as the ovary, much broader at top and narrower at base than the ovary, pubescent and punctate, teeth 5 (sometimes only 3 or 4), triangular acuminate, re-curved, much longer than the petals, punctate, pubescent, and springing without from below the prolonged inner rim of the calyx; *petals* very minute, deciduous, whitish or light pink, somewhat orbicular, jagged at apex, clawed, the very short claw dark pink. *Anthers* minute, orbicular, light pink; *filaments* white, very slender, hair-like, flexuose, crowded, numerous, always more than 20, 2 lines long, deciduous; *style* slender, much longer than the stamens, 5 lines long, wavy, persistent; *stigma* dilated and slightly emarginate; *ovary* very small, less than a line in diameter, pilose, globose, obscurely trigonous, turgid, bursting loculicidally nearly to base. The *main peduncle* or *rhachis* stout, terminal, being the continuation of the branch, 4–6 lines long, this sometimes has a

* *Vide* Trans. N. Z. Inst., Vol. X., p. 109.

short secondary peduncle at its base, springing axillary from a leaf, and trichotomously bearing three flowers nearly sessile or on very short pedicels, bi-bracteate, bracts long linear; *pedicels* on main rhachis short, under 1 line long, each having a pair of minute, scarious, punctate, and pilose bracteoles at the base.

Hab.: Forests, head of the Manawatu River, climbing lofty trees; 1874–9.

This species is pretty closely allied to *M. colensoi*, Hook., but differing from that species in its peculiar strictly drooping growth, in its decussate and densely pilose broader and coloured leaves, in its peculiar calyx lobes, and terminal panicles of *white* flowers. It is a beautiful plant in its native wilds, and will, no doubt, at some future day, become a favourite garden one, on account of its elegant pendulous habit. Its flowers are rather rarely produced, and are generally, including the calyces, gnawed by insects. I had to seek often, and to wait some years ere I could get perfect specimens. I consider it by far the most graceful of all our known New Zealand species of *Metrosideros.*

METROSIDEROS SUBSIMILIS.

A bushy diffuse climbing plant, with pale deciduous bark.

Leaves opposite, somewhat distichous, petiolate, 7–9 lines long, 4–6 lines broad, broadly ovate and acute, sometimes broadly elliptic and mucronate, sub-coriaceous, minutely punctate beneath, 3 (sub 5) nerved, midrib and lateral nerves prominent, margin entire, slightly revolute and finely ciliated, the lowest pair on a branchlet always the smallest, and often orbicular; young leaves very finely pilose on upper surface and on midrib beneath; petioles and branchlets densely and finely pilose. *Flowers* horizontal, erect, whitish, small, under 6 lines long, generally 5–7–9 together, decussate, in short racemes or thyrsoid-like panicles, always lateral, and springing directly from old wood,—sometimes, however, a small corymb of three, and more rarely a solitary one appears; *calyx* broadly campanulate, longer and broader than ovary, nerved, minutely pilose, with five (sometimes six) deltoid teeth, obtuse, persistent, minutely and regularly crenelled or sub-beaded on inner border of the rim; *petals* small, fugacious, under one line in diameter, orbicular, scarcely clawed, obscurely 3–5-veined, punctate, erose, or minutely jagged at top, limb faintly pinkish, and some with a slight tinge of red—particularly on the outside,—claw dark coloured; *anthers* small, orbicular; *filaments* slender, simple, pure white, two lines long, flexuose, spreading, not numerous (15–20), deciduous; *style* stout, subulate, erect, much longer than stamens, 4–5 lines long during flowering, afterwards 6 lines long or more, persistent; *stigma* dilated; *ovary* small, under one line diameter, globose, wholly adherent with base of calyx-tube, splitting loculicidally into three valves, the terminal or central ovary sometimes bearing a

scarious bracteole near its top; *peduncle* stout, pubescent, 6–20 lines long, pedicels slender, pubescent, 1–2 lines long, always opposite on rhachis, bracteolate, each with one or two small scarious obtuse bracteoles and several very minute acute ones at base, and often with a pair of large leafy broadly ovate punctate bracts pilose and ciliate immediately below the base of the pedicels.

Hab.—Forests at the head of the River Manawatu, where it climbs lofty trees; 1876–79.

This species, which has been long known to me in its non-flowering state, will rank near to *M. hypericifolia*, A. Cunn., which in some respects it resembles; differing, however, in its more upright manner of growth, not being so divaricate; in its leaves being petiolate, broader, pubescent, and ciliate, and not so acute; in the colour of its flowers; in its stamens being always very diffuse—not erect; in its style being much longer than its stamens; in its longer and more dilated calyx tube which is also persistent; and in its leafy panicles.

A good characteristic drawing of *M. hypericifolia* is given in the "Flora Nova Zelandia" (such as I have seen that handsome plant in the Northern woods), its flowers are *wholly* "scarlet" and very striking; but in this species its living flowers mostly appear pure white in its forests, owing to the early falling-off of its very small fugacious petals and its white spreading stamens.

Olearia colorata.

A large shrub 8–12 feet high, of erect sub-pyramidal growth; bark thin, pale; branchlets striated.

Leaves broadly lanceolate, 3–5½ inches long, 1–2 inches broad, mucronate, grossly and irregularly toothed at ends of lateral veins, teeth long subulate pointed, sub-membranaceous, rather dry, alternate, spreading, colour light-green, thickly covered *above* when young with long strigose loose woolly hairs,—*hairs* white, hoary, translucent, irregular in size and shape, branched, linear-lanceolate, broadest in middle, and tapering gradually to both ends,—and leaves densely covered *below* with closely-pressed white-brown cottony tomentum, which on the mid-rib and principal lateral veins is of a very much darker colour; lateral veins alternate at right-angles to mid-rib, conniving and coalescing within the margin; whole leaf closely filled with minute reticulated compound anastomosing veins; petioles 6–9 lines long, canaliculated, rather slender. *Flowers* axillary and sub-terminal in diffuse branching heads of loose corymbose panicles; *heads* numerous, small, crowded, 5–7 lines diameter, flowers of ray 8–14, white, patent, slightly recurved; *involucre* sub-campanulate, its scales in about three rows, lanceolate acute and densely woolly and tipped with black, each

involucre having a small linear bracteole close to its base; *pappus* numerous, white, pointed, not thickened at top, longer than involucre and shorter than the ray flowers; *achenium* (immature) glabrous, plain, not costate; *peduncles* from rhachis 1–2 inches long, always bearing an oblong obtuse bract close to their bases; *pedicels* 2–4 lines long, slender, generally with a linear bracteole at base or about the middle of pedicel, and mostly ending dichotomously with two heads of flowers; rhachis, peduncles, pedicels, involucres, and petioles, thickly covered with red-brown woolly tomentum.

Hab.—Dry forests, "Forty-mile Bush," head of the River Manawatu; 1876–1878.

This plant is, no doubt, closely allied to *O. cunninghamii*, Hook., but differing in its peculiar strigose hoary leaves, and their several curious colours, and sharp apiculated teeth, in their veinlets branching from the mid-rib at right angles, and in its pointed pappus. I have more than once thought, that Sir J. D. Hooker may have included more than one species of *Olearia* under *O. cunninghamii* in his "Handbook of New Zealand Flora." The type of that species (*Brachyglottis rani*), discovered and described by Cunningham, is a northern plant (Cunningham originally found it north of the Bay of Islands), and I have never met with it in these parts. But be that as it may, this species is neither Cunningham's plant nor the *O. cunninghamii* of Hooker. It is common in the "Forty-mile Bush" forest, and when in full flower in summer is a graceful and conspicuous object, always delighting the eye of the traveller that way with its striking masses of white blossoms. Curiously enough this plant does not flower every year. It flowered most abundantly in 1878, but in 1879 not a single shrub could I detect bearing any flowers!

It has been named *colorata* from the four colours of its leaves and petioles; the upper side of the leaf, when denuded of its hoary hairs, is a peculiar light green, below the blade is whitish with a slight tinge of ochre or light brown, while the mid-rib and larger veins are light reddish-brown, and the petioles and branchlets are a still darker shade of rich red-brown. All this is very constant and apparent, at first sight, in its living state. Its leaves are also frequently further discoloured through being punctured and gnawed by insects.

DICKSONIA SPARMANNIANA.

Plant terrestrial, cæspitose, sub-erect, many-fronded, rhizome or root-stalk rising only a few inches above ground, and in some few instances apparently shortly coalescent. *Stipe* very short, 6–9 inches, densely clothed throughout with long hairs; hairs 2 inches long, shining, chesnut-brown, articulated and moniliform their whole length; *rhachises* densely woolly and hairy with light brown, patent, glandular hairs; stipe and main-rhachis

green, sub-succulent, with a continuous, narrow, white-ridged, glabrous line, extending from pinna to pinna on both sides throughout their whole length. *Frond* obovate or cuneate, profoundly tapering downwards, or somewhat of a rhomboidal figure having two of its sides excessively produced, tripinnate, acuminate at tip, about 40 jugate, 6 feet long, broadest at 20 inches from apex, and there 18–20 inches in diameter, greatly attenuated downwards; *pinnæ* alternate, free, not crowded, longest pinna isosceles-triangular very acuminate, 9½ inches long and 3 inches broad at base (broadest part), but rapidly decreasing in breadth, being, at 2 inches from base, only 2 inches broad; pinnæ at base of frond very small, 2–2½ inches long, and distant, only 6–7 in the lowest foot on both sides, and fully 15–18 inches from lower end of rhachis before any approach to pairs; *pinnules* petiolate, straight or inclined forwards, triangular, 12–14 lines long, 4–5 lines broad, broadest at base, very acute, alternate; *segments* not crowded, oblong-ovate, sub-falcate, alternate, sessile, save lowermost pair on pinnule, decurrent, sharply toothed, the largest barren ones having 10–11 acute, almost spiny, teeth, fertile ones with fewer teeth and sub-revolute; texture membranaceous, both sides more or less hairy, particularly on mid-rib of pinnules; hairs on upper surface loose, hoary; *veins* pinnate, veinlets forked at apex, some simple, free; *sori*, generally four on largest segment, small, not crowded; *involucres* very globose and inflated, margins entire; valves large, especially the outer one which is cucullate, and partly composed of a different texture from that of the frond—not unlike that of a *Cibotium.*

Hab.—In hilly shaded forests, western slopes of Ruahine Range, head of river Manawatu, 1877–80.

This fern in some respects approaches to our *D. fibrosa*, but is very distinct. There is a common family resemblance among most of the large *Dicksoniæ*, rendering it difficult to discriminate species,—especially from merely dried specimens and portions of fronds. Here, however, the peculiar hairs afford a good character, also the sori and the striking outline of the frond (there are also others more or less minute). The very local and distinct *D. arborescens*, of St. Helena, the type of the genus, has also similar moniliform hairs. The time is rapidly approaching when ferns will be more truly and naturally classified (as to species) by their peculiar and never-varying natural microscopical characters;—much as now obtains among the *Hepaticæ* and *Musci*, the *Umbelliferæ* and *Compositæ*. This species is a very handsome growing plant, with its bold fine-spreading crown; in its manner of growth resembling its neighbours *Aspidium aculeatum** and *Lomaria discolor*—but is as a giant among them! I have known it for

* In giving the name from the "Handbook, New Zealand Flora," by which this handsome fern is therein described, I do *not* subscribe to its being identical with the British species of that name.

several years, but only last year, for the first time, found it bearing fruit in great profusion.

I have honoured myself by naming it after a disciple and fellow-countryman of Linnæus—Dr. Sparrman—who was one of the earliest botanists in New Zealand, accompanying Captain Cook and the two Forsters hither on his second voyage of discovery. Of Sparrman, his fellow-voyager Dr. Forster says in his preface to his classical *Genera Plantarum:*—"Sparmannus plantas describebat, Filius easdem delineabat.—Verum dum Sparmannus plantas accuratius examinaret, filius et ego sæpe in consilium vocati in commune consulebamus, etc.,"—and yet nothing in New Zealand has ever been named after him !†

HYMENOPHYLLUM PUSILLUM.

Plant both epiphytical and terrestrial; rhizome red, wiry, creeping, hairy; hairs red.

Frond 4–8 lines long, oblong-ovate, obtuse, pinnate, 4–5 jugate, bearing long, red, broad, curved scales on its veins on both surfaces; *pinnæ* petiolate free, mostly opposite, lobed or sub-pinnatifid on the upper side only, lowermost pair always opposite and generally 3-lobed; *rhachis* not winged, save a very little at top, lobes very small and confluent at apex; *stipe* 3–7 lines long, capillary, flexuose; stipe and rhachis bearing scattered red chaffy scales; *segments* or lobes, obovate-elliptic, not linear, very obtuse or truncate, semi-transparent, largely serrate or laciniate, the teeth or laciniations very long for size of plant and wholly composed of the fine texture of the frond and often revolute never spinulose, generally five teeth at the apex of a lobe; *involucres* terminal and supra-axillary on the uppermost pinnæ, obovate, divided about halfway down, not compressed, and bearing red hairy scales; lips toothed; *receptacle* included; *sori* red.

Hab.—On trunks of living trees, and on the earth at their bases, in dense shady forests throughout the North Island, but sparingly. First detected (barren) on Te Ranga mountain, head-waters of Waikare, Bay of Islands, 1836; again (but barren) at the head of the Wairarapa Valley, 1852; and again, and in fruit, in the forests, west slopes of Ruahine mountain range, near the head-waters of the River Manawatu, 1878-9-80; generally found on *Olea* sp.

This little plant is nearly allied to *Hymenophyllum tunbridgense*, *H. revolutum* (mihi),‡ *H. minimum*, and other of the smaller *Hymenophyllæ;* but on close comparison with them (living specimens) it will be found to be abundantly distinct. To me it appears as a necessary needful species re-

† *Vide* "Transactions N.Z. Inst., Vol. I., "Essay on the Botany of the North Island, N.Z.," pp. 55, 56, for more.

‡ Tasmanian Journal Natural Science, Vol. I., p. 186.

quired to connect those species above referred to in a natural sequence. It is one of those ferns which, though distinct, it is difficult to describe specifically in words, as Sir W. J. Hooker, long ago, often remarked in his valuable works on ferns. Having, however, lately obtained specimens of *Hymenophyllum tunbridgense* (*vera*) from England, I am positive of its specific distinction; the typical British plant being wholly glabrous, having its rhachis strongly winged throughout (extending downward in some instances to the upper part of its stipe), its lobes always narrow "*linear*," and serrate not slashed, teeth spinulose and hard not thin, with only 2–3 teeth at the apex of a lobe, and its fructification invariably supra-axillary and never terminal. But with botanists who make but *one* species of those two widely differing ferns—*H. tunbridgense* and *H. wilsoni*—of course this little fellow would be only deemed a variety of *H. tunbridgense*.

TRICHOMANES VENUSTULA.

Plant creeping, epiphytical, pendulous on trunks of living trees; rhizome capillary, creeping, woolly.

Fronds pendulous, pinnate, 4–6 (sometimes 7) jugate, dark-green, glabrous, semi-transparent, oblong, somewhat deltoid, obtuse, 1–2 inches long, 6–12 lines wide; *pinnæ* petiolate, close not crowded, tolerably regular, lowermost pair mostly opposite and generally the largest, flabellate and rhomboid-acuminate, sub-pinnatifid or deeply cut on both sides, trinerved, each nerve a little waved and giving out pinnate veins, veinlets simple or forked, margin slightly sinuous; *segments* generally 3–5 on a pinna, obtuse or retuse, cuneate at base, middle one linear and much produced; *involucres* scattered on both edges of pinnæ, 2–5 on a pinna, upper half free or with one side attached to frond, tubular or slightly funnel-shaped, mouth much dilated, plane, equal all round: *receptacle* setaceous and exserted, 2–6 lines long, curved; *rhachis* winged slightly at apex; *stipe* 9–12 lines long, capillary, flexuose; both stipe and rhachis green, nearly same colour as frond: stipe always black at base.

Hab.—On trunks of living trees, dense shady damp forests, west slopes of Ruahine mountain range, head of the River Manawatu; 1878-9.

This little novelty is nearly allied to *Trichomanes venosum*, Brown; differing, however, in several respects, especially in its sub-flabellate trinerved pinnæ, in its rhachis not being winged, and in its involucres, which are also numerous and scattered on both edges of its pinnæ.

While growing pretty plentifully in that locality, though only hitherto detected on a few trees, it is not very often found in fruit; at the same time some insect seems to be very fond of its fronds, which are generally more or less gnawed. Showing, in this respect also, a great difference to its ally *T. venosum*, which, on the neighbouring tree-ferns, luxuriates untouched in

all its glossy beauty. It was only in this last year (1879), after very diligent research, that I succeeded in obtaining good fruiting specimens of this plant.

P.S.—Specimens of all the Plants described in this Paper have been forwarded with it to the Manager of the New Zealand Institute, for the Herbarium of the Colonial Museum, Wellington.

ART. LV.—*Contribution to the* Lichenographia *of New Zealand*.

By CHARLES KNIGHT, F.L.S.

Plates XII. and XIII.

[*Read before the Wellington Philosophical Society*, 21*st February*, 1880.]

1. *Sticta amphisticta*, Kn.

Thallus pallido-ochro-fuscescens aut passim hepatico-fuscescens ambitum versus sæpe fuscus mediocris lævis parum rigescens, supra punctis albis sparsis pseudo-cyphelloideis minutis conspersus, laciniato-divisus, laciniis subcaniculatis varie lobatis v. grosse sinuato-crenatis, apice dichotomis v. obtusis; subtus ochro-fuscus aut pallido-fuscescens medio fusco-tomentosus; cyphellæ urceolatæ pallidæ, margine sæpe prominulo; cephalodia concoloria minuta parca. Apothecia sparsa badio-rufa, margine tenui crenulato pallido aliquando integro. Sporæ incolores v. dilute luteolæ oblongo-fusiformes v. oblongæ, 1–3-septatæ, longit. ·026, crassit. ·007 mm.

Ad cortices.

2. *Sticta episticta*, Nyl.

Thallus ochroleucus v. pallido-ochraceo-fuscescens mediocris vix nitidiusculus, supra punctis albis pseudo-cyphelloideis minutis sparsis conspersus, laciniatus, laciniis varie lobato-divisis subcaniculatis ambitu minute crenatis passim ibi laciniatulo-dissectis v. fere isidiosis; subtus ochraceus puberulus subnudus medio fusco-tomentosus, cyphellis parvis urceolatis perpaucis v. nullis pallidis, cephalodiis concoloris minutis parcis. Apothecia rara v. rarissima badio-rufa margine thallino crenulato v. leviter denticulato-inæquali cincta. Sporæ incolores v. dilute luteolæ oblongo-fusiformes v. oblongæ, 1–3-septatæ, longit. ·03, crassit. ·007 mm.

Ad cortices.

3. *Pannaria atrofumosa*, Kn.

Thallus cæruleo-olivaceus v. atro-fumosus squamulosus diffracto-areolatus, squamulis minutis concavis crenato-orbiculatis ambitu minutissime granulosis v. furfuribus, hypothallo atro late marginatus. Apothecia innata

v. immixta lecanorina intus incoloria, disco plano luteo-rubro v. luteo-fusco in centro plerumque fisso v. depresso v. decolore, margine nonnihil gyrato elevato minutissime granuloso, paraphysibus capillaribus discretis. Sporæ in ascis cylindricis uniseriales ellipsoideæ incolores, longit. ·015, crassit. ·008 mm.

Ad cortices.

Pannaria immixta v. gyrantha, Nyl. in litt.

4. *Pannaria apiculata*, Kn.

Thallus sordide fuscus passim fumoso-fuscus v. plumbeo-cinereus minute squamuloso-microphyllinus (squamulis nonnihil laciniato-effiguratis) v. diffracto-areolatus v. detritus tum demum hypothallo nigro passim v. omnino nudo. Apothecia biatorina brunnea v. rufo-nigra plana interdum convexa intus incoloria v. omnino dilute luteola, margine pallidiore tenui integro. Sporæ in ascis late cylindricis ellipsoideæ sæpissime utrinque apiculatæ dilute fuscescentes, longit. ·018, crassit. ·009 mm.

Ad cortices.

5. *Pannaria triptophylla*, Ach.

Apothecia biatorina margine erecto. Sporæ ellipsoideæ. *Hypothecium fusco-nigricante.* Hypothallus cæruleo-nigricans.

Ad cortices.

6. *Pannaria subsimilis*, Kn.

Thallus glauco-cervinus squamulosus v. microphyllo-squamulosus, squamulis membranaceis contiguis adpressis rotundato-incisis singulis e centro radiantibus, granulis gonimis cærulescentibus, hypothallo cærulescenti-nigro limitatus. Apothecia rubra v. croceo-rubra biatorina plana marginata, margine pallido integro tenui discum æquante, excipulo proprio luteo-fusco, hypothecio concolore, paraphysibus gracilibus non bene discretis (apice non dilatis et vix incoloratis). Sporæ in ascis cylindraceis ellipsoideæ incolores v. dilute luteolæ, longit. ·015, crass. ·006 mm.

Ad cortices.

The colour of thin sections of the apothecia seen by *reflected* light is a delicate rufous yellow.

Syn.: *Pannaria nigro-cincta*, Nyl., Handbook New Zealand Flora, fol. 575.

There is some confusion in respect of Montagne's lichen. Both Babington and Nylander consider the New Zealand lichen to be the *Psoroma nigro-cincta* of Montagne. But in fact Montagne's plant, of which there is an authentic specimen in the Kew Museum (probably contributed by Montagne himself), is a true *Psoroma;* the thallus with large green gonidia, apothecia *biatorine*, excipulum of a pale brown or "Indian pink," and agreeing closely with the description in "Sylloge Plant. Crypt." On the other hand No. 51 of Leighton's Ceylon Lichens, "*Pannaria nigro-cincta*, Mont," is a true *Pan-*

C Knight. del.

LICHENES.

J.B. lith.

naria; apothecia *lecanorine* with "granulæ gonimæ" in place of gonidia, the granules large, cæruleo-glaucescent, margin prominent, crenulate. Again, No. 142, Spruce's Lich. Amaz. et And., is a true *Psoroma:* apothecia biatorine symphycarpous, margin obscure, spores smaller, and the thallus with well defined layer of gonidial masses.

7. *Pannaria amphibola*, Kn.

Thallus e glauco-rufescente helvolus microphyllinus, phyllis subimbricatis planiusculis lobulatis, lobis crenatis ambitu albo-furfuraceis, granulis gonimis glauco-cærulescentibus, hypothallo rubro-fusco v. nullo. Apothecia luteo-rufa biatorina plana marginata intus luteo-fusca, margine concolore integro, paraphysibus crassis adglutinatis. Sporæ ellipsoideæ interdum utrinque attenuatæ simplices incolores, longit. ·012, crass. ·006 mm.

Ad cortices.

P. amphibola, Nyl. in litt.

8. *Pannaria biatorina*, Kn.

Thallus albo-virescens squamulosus, squamulis adpressis minutis crenulatis, granulis gonimis glauco-virescentibus, hypothallo nigro. Apothecia biatorina sparsa aurantiaca (diam. 0·4 mm. v. minora) superficialia intus pallida marginem pallidiorem demum æquantia, margine primo elevato integro, paraphysibus capillaribus adglutinatis. Sporæ in ascis clavatis ellipsoideæ subhyalinæ demum dilute luteolæ granulosæ, longit. ·02 mm., crassit. ·01 mm.

Supra Jungermannias.

9. *Pannaria subimmixta*, Kn.

Thallus glauco-albescens squamulosus, squamulis parvis rotundis crenatis confertis v. imbricatis, hypothallo nigro, granulis gonimis glauco-viridis v. glauco-brunneis 1–4 in nodulo singulo (microscopii area granula gonima obsita). Apothecia lecanorina fusca v. brunnea plana, margine crenato. Sporæ uniseriales simplices ellipsoideæ, longit. ·014, crass. ·008 mm.

Supra terram et lapides.

10. *Physcia plinthiza*, Nyl.

Thallus albo-glaucescens corrugatus rotundato-lobato-incisus in centro granulatus, laciniis arcte adpressis ambitu obscure crenatis. Apothecia madefacta diam. 1·7 mm. intus incolorata v. dilute glaucescentia, disco fusco v. atro-fusco plano, margine subinflexo tumido crenulato, excipulo thallino celluloso gonimico, gonimia magna numerosa, excipulo proprio (hypothecio) ex utroque latere evanescente, paraphysibus discretis apicibus elliptico-dilatis. Sporæ in ascis cylindraceo-saccatis ellipsoideæ fuscæ 4–6-loculares, loculis tubulo junctis et mediis sæpe didymis (ita medio series 2 adsunt transversæ biloculares), longit. ·03, crassit. ·012 mm.

Ad cortices.

11. *Lecanora babingtonii*, Mass.

Thallus tenuis albo-cinereus granulosus v. minutissime squamulosus, squamulis arcte adpressis. Apothecia rosea v. luteo-coccinea (diam. 1·5 v. minora) marginata, margine granulato tandem flexuoso, excipulo thallino albido v. dilutissime colorato gonidia continente, excipulo proprio fibrato supra evanescente, paraphysibus non bene discretis apice minute granulosis non dilatis. Sporæ in ascis saccatis subarcuatæ v. leviter curvatæ aciculari-fusiformes 5-septatæ, longit. ·035, crassit. ·004 mm.

Ad cortices.

Probably Babington's *L. punicea*, *Ach.* (Flora N.Z., p. 292). Comparing our lichen with Leighton's *L. punicea* (Ceylon Lichens, No. 62), it is seen that the thallus of the latter is fusco-cinereous, while the spores are ·07 mm. in length, and the septæ from 7–15 in number (v. fig. No. 11, b.), and these measurements agree with Nylander's figure, v. Nylander's *Lichenes Novo-Granatenses*, p. 32, fig. 7, tab. 1, reproduced here to the same scale as all the other figures are drawn, v. fig. No. 11, c.

12. *Bacidia subscripta*, Kn.

Thallus sordide cinerascens v. sordide cinereo-albidus tenuis continuus v. minute areolatus v. fissus indeterminatus. Apothecia superficialia atro-fuscescentia nuda plana v. concava marginata (diam. 1 mm.)—raro in juniore pallide fusca—margine concolore tenui, excipulo dilute fuscescente a lateribus v. a basi et lateribus per lineam tenuem fuscam contento, strato subhymeniale e pseudo-gonidiis liberis sphæricis incoloratis—aliis minutis aliis sat grandibus—formato, paraphysibus brevibus subcrassis adglutinatis grumosis. Sporæ in ascis clavatis fusiformi-aciculares subspiraliter contortæ v. in arcum curvatæ 3–7 septatæ v. simplices (septis invisis ?), longit. ·04, crassit. ·0035 mm.

Ad cortices arborum.

13. *Bacidia glomerulosa*, Kn.

Thallus sordide ochraceo-cinerascens byssaceo-pulverulens ubique diffractus v. dehiscens granulas gonimas virides in nodulis magnis receptas continens. Apothecia adnata v. innata (diam. 0·5 mm.) atro-fusca, margine evanido, excipulo dilute colorato, hymenio fusco, paraphysibus gracilibus non bene discretis apicibus fuscis. Sporæ rectæ aciculares 3–7 septatæ, longit. ·035, crassit. ·0025 mm.

Ad cortices arborum.

14. *Bacidia eucoccodes*, Kn.

Thallus cinereo-viridescens granulosus v. microphyllino-granulosus effusus granulas gonimas virides in nodulis receptas continens. Apothecia innata v. adnata fusco-atra plana v. convexa marginata (diam. 1·3 mm.), margine concolore obscuro demum tenui, excipulo dilutissime colorato ab

linea atro-fusca cincto, paraphysibus gracilibus discretis. Sporæ in ascis clavatis aciculares gracillimæ infra attenuatæ rectæ sat 14-septatæ, longit. ·06, crassit. ·0015 mm.

Ad cortices arborum.

15. *Bacidia spirospora*, Kn.

Thallus cinerascens tenuis lævis continuus v. subtiliter fissus, gonidia vera offerens, per lineam atram determinatus. Apothecia nigro-fusca (diam. 1 mm.) plana demum convexa marginata, margine concolore, paraphysibus gracilibus non bene discretis, apicibus fuscis subincrassatis. Sporæ in ascis clavatis aciculares infra attenuatæ circiter 18-septatæ, septis distinctis, maxime spiraliter curvatæ, longit. ·06, crassit. ·003 mm.

Ad cortices arborum.

16. *Bacidia melastegia*, Kn.

Thallus sordide albo-ochraceus tenuis continuus. Apothecia minuta (diam. 0·4 mm.) atro-fusca plana adnata, margine pallidiore—intus fuliginoso,—excipulo dilute colorato, strato subhymeniale fuscescente, paraphysibus gracilibus apice anthracinis. Sporæ in ascis clavatis aciculares utrinque attenuato-acutæ 13–20 septatæ spiraliter curvatæ, longit. ·075, crassit. ·002.

Lecidea melastegia, Nyl. in litt.

Ad cortices arborum.

17. *Bacidia anceps*, Kn.

Thallus cinerascens tenuis minute albo-granulosus continuus. Apothecia rufo-fusca v. nigro-fusca (diam. 1 mm.) marginata, disco plano, margine crasso fusco (intus fusco), excipulo crasso dilute luteo cellulari (cella quadrata) in granulis comminuatur, strato subhymeniale dilute succineo, paraphysibus discretis. Sporæ aciculares utrinque acutæ infra attenuatæ circiter 16-septatæ, septis distinctis, longit. ·07, crassit. ·002 mm.

Ad cortices arborum.

18. *Bacidia cerasentera*, Kn.

Thallus albo-cinereus areolatus tenuissimus v. macula alba indicatus. Apothecia atra minuta (diam. 0·4 mm.) innata v. adnata, in juvenis sæpe e thallo albo marginata, intus fusca v. purpureo-fusca, excipulo atro, margine concolore obscuro, paraphysibus crassis brevis excipulo atro enatis apice bulbosis purpureo-atris non bene discretis. Sporæ in ascis clavatis fusiformi-aciculares in arcum curvatæ 7–9 septatæ v. minus clare septatæ, longit. ·045, crassit. ·004 mm.

Lecidea cerasentera, Nyl. in litt.

Ad cortices arborum.

19. *Bacidia melasema*, Kn.

Thallus ochraceo-cinerascens tenuissimus squamulosus, squamulis minutis arcte adpressis, continuus linea atra limitatus. Apothecia ad-

nata atra convexa (diam. 0·8 mm.) intus colorata immarginata, excipulo glauco-nigricante v. nigro, strato subhymeniale (in sectione subtilissima) viridulo e pseudo-gonidiis liberis sphæricis oleaceis dilute viridis (aliis minutissimis aliis sat grandibus) formato, paraphysibus non discretis. Sporæ fusiformi-aciculares curvatæ circiter 7-septatæ, longit. ·032, crassit. ·004 mm.

Lecidea melasema, Nyl. in litt.

Ad cortices arborum.

20. *Bacidia mesospora*, Kn.

Thallus tenuis sordide fuscus effusus leproso-pulverulens. Apothecia luteo-rubella plana demum convexa (diam. 0·4), margine concolore demum obscuro, excipulo incolore, paraphysibus gracillimis adglutinatis. Sporæ in ascis clavatis bacillares rectæ non supra 8-septatæ, interdum septis obscuris, longit. ·024, crassit. ·003 mm.

Ad cortices arborum.

21. *Bacidia stenospora*, Kn.

Thallus sordide ochraceus tenuis subtilissime areolo-granulosus (farinosus) indeterminatus. Apothecia pallido-livida ceracea plana adnata appressa (diam. 0·7 mm.) immarginata, excipulo luteo-fusco textura radiatim disposita, paraphysibus adglutinatis obscuris apice incoloratis non dilatis. Sporæ in ascis (longit. ·085, crassit. ·005 mm.) bacilliformibus aciculares rectæ gracillimæ circiter 30-septatæ, septis parum obscuris, longit. ·075, crassit. ·0015 mm.

Ad cortices arborum.

22. *Bacidia pedicellata*, Kn.

Thallus cinerascens tenuissimus continuus. Apothecia superficialia (diam. 1·1 mm.) rufa v. fusco-rufa convexa nonnihil subglobosa unde quasi pedicellata intus dilute fusco-lutea, margine obtuso concolore demum obscuro, strato subhymeniale fusco, paraphysibus concretis gracilibus apice non dilatis. Sporæ aciculares rectæ circiter 28-septatæ, septis distinctis, longit. ·085, crassit. ·003 mm.

Supra Jungermannias.

23. *Bacidia rimosa*, Kn.

Thallus cinerascens tenuissimus effusus diffractus rimosus. Apothecia e strato thallode gonidiale enata rufa tandem rufo-fusca (diam. 0·6 mm.) plana marginata, margine concolore v. dilute concolore demum obscuro, excipulo dilute luteo, strato subhymeniale fusco, paraphysibus gracilis non bene discretis apice grumosis. Sporæ aciculares infra attenuatæ, supra obtusæ, rectæ circiter 20-septatæ, longit. ·054, crassit. ·0025 mm.

Ad cortices arborum.

24. *Bacidia carneo-rufa*, Kn.

Thallus olivaceo-fuscus tenuis leprosus effusus. Apothecia carneo-rufa (diam. 1 mm.) plana, margine concolore, excipulo pallido, strato subhymeniale fusco, paraphysibus adglutinatis apice non dilatis. Sporæ aciculares supra obtusæ infra attenuatæ rectæ circiter 15-septatæ, longit. ·065, crassit. ·002 mm.

Ad cortices arborum.

25. *Bacidia rosello-carnea*, Kn.

Thallus ochro-cinerascens v. ochro-fuscescens leproso-granulatus tenuis continuus v minute areolatus interdum subrugulosus indeterminatus. Apothecia (diam. 0·5 mm.) adnata plana v. convexa sordide rosello-carnea tandem fuscescentia sæpius in parte decolorata intus luteo-fusca, margine concolore v. pallidiore demum evanescente, paraphysibus adglutinatis obscuris grumosis apice non dilatis. Sporæ vermiformi-aciculares subspiraliter curvatæ circiter 10-septatæ, longit. ·05, crassit. ·002 mm.

Ad cortices arborum.

Lecidea rosello-carnea, Nyl. in litt.

26. *Bacidia pseudo-pyrra*, Kn.

Thallus olivaceo-fuscus tenuissimus (pellucidus? unde matrice perlucente thallus coloratus). Apothecia luteo-alba minuta (diam. 0·3 mm.) convexa, margine concolore obscuro, excipulo incolore v. strato subhymeniale dilute fusco, paraphysibus adglutinatis obscuris non grumosis. Sporæ in ascis clavatis bacillares subcurvatæ circiter 8-septatæ, longit. ·04, crassit. ·0025 mm.

Ad cortices arborum.

Closely allied to *B. albescens*, Hepp.

27. *Bacidia leuco-carpa*, Kn.

Thallus albido-cinerascens leproso-granulosus tenuissimus indeterminatus. Apothecia albida v. carneo-alba adnata plana v. convexa immarginata (diam. 0·8 mm.), strato subhymeniale luteo-fusco, paraphysibus adglutinatis obscuris grumosis. Sporæ vermiformi-aciculares subspiraliter curvatæ sat 10-septatæ, longit. ·06, crassit. ·002 mm.

Ad cortices arborum.

28. *Bacidia spodoelæina*, Kn.

Thallus cinereo-olivaceus tenuis sublævis continuus indeterminatus. Apothecia fusca v. fusco-nigra (diam. 0·6 mm.) convexa, margine concolore, disco in juvenis aliquando pruinosa, excipulo albo, strato subhymeniale incolorato, paraphysibus gracilibus non bene discretis apice non dilatis. Sporæ bacillares circiter 18-septatæ rectæ v. leviter curvatæ, longit. ·06, crassit. ·003 mm.

Ad cortices arborum.

29. *Bacidia chryso-carpa*, Kn.

Thallus albus v. sordide albescens tenuissimus subleprosus v. leproso-granulatus v. pulverulens indeterminatus. Apothecia flavescentia convexa (diam. 0·8 mm.), margine concolore indistincto demum excluso, excipulo (viso per reflectam lucem) albo, strato subhymeniale dilute luteo-fusco, paraphysibus adglutinatis gracilibus non grumosis apice non dilatis. Sporæ aciculares gracillimæ, septis invisis, longit. ·06, crassit. ·002 mm.

Ad cortices arborum.

30. *Bacidia nanospora*, Kn.

Thallus cinereus tenuis subleprosus, granulas gonimas virides in nodulis magnis receptas continens. Apothecia e thallo oriunda (in juniore biatorina urceolata, disco sordide fusco, margine pallidiore ceraceo prominente erecto, strato subhymeniale dilute luteo-fusco) tandem convexa (diam. ·6 mm.) fusca, margine obscurato, excipulo fusco, paraphysibus adglutinatis brevibus. Sporæ in ascis clavatis vermiformi-aciculares, septis invisis, longit. ·02 mm., crassit. ·0013 mm.

Ad cortices arborum.

31. *Bacidia pannaroidea*, Kn.

Thallus sordide ochraceo-cinereus carroso-leprosus spongiosus diffractus, granulas gonimas virides in nodulis magnis receptas offerens. Apothecia rufa v. rufo-fusca (diam. 1·2 mm.) margine concolore obtuso demum tenui, excipulo fusco, strato subhymeniale atro-fusco, paraphysibus non bene discretis gracilibus apice non dilatis. Sporæ aciculares infra attenuatæ gracillimæ rectæ sat 16-septatæ, longit. ·06 ad ·09, crassit. ·0015 ad ·002 mm.

Ad cortices arborum.

32. *Bacidia rhodocarpa*, Kn.

Thallus sordide ochraceus v. cinerascens pulverescens continuus, granulas gonimas in nodulis magnis receptas continens. Apothecia luteo-rufescentia v. rubra v. demum fuscescentia plana marginata (diam. 0·8 mm.) margine concolore demum obscuro, excipulo luteo-fusco, strato subhymeniale atro-luteo-fusco, paraphysibus capillaribus discretis, apicibus non dilatis. Sporæ aciculares rectæ circiter 20-septatæ, longit. ·06, crassit. ·002 mm.

Ad cortices arborum.

33. *Bacidia albido-prasina*, Kn.

Thallus glauco-albidus v. albo-smaragdinus tenuis lævis continuus linea nigra limitatus. Apothecia carneo-alba adnata plana v. convexa (diam. 0·4 mm.) margine pallidiore demum obscuro, excipulo luteo-fusco, paraphysibus adglutinatis apice non dilatis. Sporæ aciculares simplices (septis invisis) gracillimæ, longit. ·05, crassit. ·002 mm.

Ad cortices arborum.

34. *Lecidea cerinocarpa*, Kn.

Thallus cinereo-viridis tenuis pulverescenti-granulatus, gonidiis veris flavo-virescentibus, interdum granulis gonimis in nodulis magnis receptis. Apothecia ceraceo-carneo-lutea convexa interdum discolorata marginata (diam. 0·8 mm.) intus incolorata, margine exacte concolore ex quo obscurato, paraphysibus capillaribus discretis. Sporæ in ascis cylindraceis uniseriales ellipsoideæ simplices incolores, longit. ·013 mm., crassit. ·006 mm.

Ad cortices.

35. *Lecidea rhypoderma*, Kn.

Thallus sordide fusco-virescens congesto-isidioso-farinosus friabilis diffractus, gonidiis veris flavo-virescentibus in massis magnis glomeratis. Apothecia fusca v. fusco-rufescentia adnata (diam. 1 mm. v. minora) convexa immarginata intus luteo-fusca, strato subhymeniale fusco, paraphysibus brevibus (circiter ·04 mm.) adglutinatis apice non dilatis. Sporæ cylindraceo-oblongæ incolores, longit. ·008 ad ·01, crassit. ·002 mm.

Ad cortices.

The spores sometimes show a faint trace of a septum.

36. *Lecidea parvifolia v. corallina*, Tuck.

Thallus cinereo-glaucus squamuloso-microphyllinus continuus, squamulis corallinis v. lobato-palmatis, gonidiis veris flavo-virescentibus, hypothallo pallide fibrilloso passim conspicuo. Apothecia biatorina luteo-rubella plana immersa v. superficialia marginata intus pallida, margine concolore, disco plano interdum in centro depresso, paraphysibus hand bene discretis. Sporæ in ascis parvis obovodeis ellipsoideæ simplices incolores, longit. ·01, crassit. ·003 mm.

Ad cortices.

Agrees with Leighton's Ceylon Lichens No. 109, except that the spores are somewhat smaller (·015 × ·004 mm.); but differs widely from No. 110, in which the thallus is thin, powdery, and hypothecium black.

37. *Lecidea microdactyla*, Kn.

Thallus pallide cinereo-viridescens flocculoso-corallinus v. flocculoso-granulosus continuus, hypothallo pallido byssoideo, gonidiis veris flavo-virescentibus. Apothecia biatorina luteo-rubella intus incolorata strato gonimico enata, margine evanescente, paraphysibus non discretis. Sporæ cylindraceo-ellipsoideæ simplices, longit ·015, crassit. ·0025.

Ad cortices.

38. *Lecidea conisalea*, Kn.

Thallus albo-viridescens pulverulentus tenuis continuus, gonidiis veris flavo-virescentibus. Apothecia biatorina luteo-rubella plana v. convexa marginata intus incolorato (diam. 1 mm. v. minora), margine tenui vulgo

pallidiore demum tenuissimo v. evanescente, paraphysibus capillaribus distinctis. Sporæ ovoideæ simplices incolores, longit. ·015, crassit. ·006 mm.

Ad cortices.

39. *Lecidea semipallida*, Kn.

Thallus cinerascens tenuissimus v. evanescens v. nihil nisi matrix pulvere conspersa. Apothecia rufa minuta biatorina (diam 0·15 mm.) intus rufo-pallida immarginata, paraphysibus grumosis. Sporæ minutæ incolores simplices oblongo-ellipsoideæ, longit. ·01 mm., crassit. ·003 mm.

Ad cortices.

Lecidea semipallida, Nyl. in litt.

40. *Lecidea albiprætexta*, Kn.

Thallus albidus v. cinereo-albidus minute granulosus tenuis continuus (matricibus diffractis) indeterminatus. Apothecia superficialia parum urceolata parva (diam. 0·35 mm.) rosea v. incarnata intus tota albida margine albescente prominulo integro cincta, paraphysibus capillaribus subglutinatis. Sporæ in ascis clavato-ventricosis simplices ovoideæ oleosæ v. granulosæ, longit. ·017, crassit. ·01 mm.

Ad cortices.

41. *Lecidea glandulosa*, Kn.

Thallus albo-cinereus tenuis leprosus v. leproso-squamulosus granulas gonimas virides in nodulis magnis receptis continens. Apothecia rufo-fusca v. luteo-fusca plana demum convexa intus incolorata, margine concolore demum evanescente, hymenio supra fusco, excipulo proprio incolorato structuram radiatam offerente, paraphysibus capillaribus non bene discretis apice coloratis nonnihil granosis. Sporæ in ascis oblongis simplices ovoideæ nonnihil oleosæ v. granulosæ, longit. ·015, crassit. ·008 mm.

Ad cortices.

42. *Lecidea coccodes*, Kn.

Thallus ochro-olivaceus tenuis granulatus indeterminatus. Apothecia rufo-fusca v. atro-fusca (diam. 0·6 mm.) marginata, disco plano, margine concolore tumido, intus dilutissime fulva, paraphysibus capillaribus non bene discretis apice dilatis. Sporæ in ascis oblongo-clavatis ovoideæ nonnihil granulosæ simplices incolores, longit. ·015, crassit. ·009 mm.

43. *Platygrapha macrospora*, Kn.

Thallus ochroleucus granulosus tenuis indeterminatus. Apothecia atra innata (diam. 0·7 mm.) plana difformia a thallo granuloso prætecta immarginata; hymenium coloratum hypothecio crasso fusco-nigro enatum; excipulum nullum; paraphyses adglutinatæ subgrumosæ. Sporæ aciculares rectæ circiter 18-septatæ incolores, longit. ·065, crassit. ·0025 mm.

Ad cortices arborum.

Lecidea interponens, Nyl. in litt.

C. Knight. del.

LICHENES

J.B. lith.

44. *Platygrapha myriommata*, Kn.

Thallus albido-viridi-cinerascens v. albo-cinerascens minute areolato-granulosus sub-indeterminatus. Apothecia prominentia a thallo albo ocellato prætexta—in initio alia abortiva, disco atro sæpe in centro albo intus carbonaceo, partim fecunda tum plana v. convexa ferruginosa demum tenuiter a thallo prætexta; hymenium fusco-rubicundum hypothecio nigro enatum; excipulum proprium nullum; paraphyses breves ambigue implicatæ non-discretæ. Sporæ in ascis clavatis aciculares utrinque attenuatæ rectæ v. subcurvatæ 3–5 septatæ v. simplices, longit. ·04, crassit. ·0025 mm.

Ad cortices arborum.

45. *Platygrapha mecistospora*, Kn.

Thallus albo-cinereus v. albo-glaucescens rimuloso-areolatus v. continuus. Apothecia lecedeiformia (diam. 0·7 v. minora) nigra intus fuscentia v. rubro-fuscescentia, juniora innato-emergentia concava dein adnata plana v. convexa excipulo proprio (perithecio) atro-fusco integro marginata, epithecio fusco grumoso indurato (excipulo proprio continuato), paraphysibus discretis subtilissimis ramosis apice grumosis excipulo atro enatis. Sporæ in ascis elongato-cylindraceis aciculari-cylindricæ 16–35-septatæ, longit. 0·13, crassit. ·0035.

Ad cortices.

Lecidea pleistophragmia, Nyl. in litt.

46. *Verrucaria leptostegia*, Kn.

Thallus cinerascens areolato-diffractus indeterminatus. Apothecia semi-immersa minuta globosa; perithecium nudum atrum convexum v. hemisphericum; paraphyses graciles discretæ amphithecio tenui dilute fusco oriundæ. Sporæ in ascis cylindraceis oblongæ v. fusiformi-oblongæ v. obovatæ dilutè luteolæ, longit. ·02, crassit. ·006 mm.

Spermagonia immersa minuta globosa; spermatia oblonga v. linearia 4-septata, longit. ·013, crassit. ·004 mm., conceptaculo tenui oriunda.

It is not absolutely certain that the spermagones, described above, belong to *V. leptostegia*. Hitherto I have failed to find apothecia and spermagones on the same thallus, except in the specimen from which the above description is drawn, and even in this instance they are not thoroughly mixed together, while the thallus on which the spermagones were found is certainly of a somewhat lighter tint than the portion bearing apothecia, although in every other respect it is uniform. This scarcely perceptible difference in depth of tint is not of itself important. The spermatia, it will be seen, resemble in every respect those of *Verrucaria byssacea (vera)*, Schær. (vide Leighton's figure No. 4, Plate XVI., Angiocarpous Lichens); but differ widely from the simple spermatia found on Schærer's own specimen, No. 286, Lich. Helv. Exsicc.

47. *Megalospora dispora*, Kn.

Thallus cinereus granulatus continuus. Apothecia atro-fusca superficialia convexa (diam. 0·6 mm.) immarginata; excipulum proprium dilute ochraceum; hymenium grumosum fuscidulum paraphysibus væris destitutum hypothecio crasso dilute luteo enatum. Sporæ in ascis pyriformibus binæ ellipsoideæ simplices incolores, longit. ·042, crassit. ·02 mm.; episporium et endosporium corio crasso disjuncta.

Ad cortices.

48. *Lecanora homologa*, Nyl.

Thallus sordide albo-cinereus sublævis indeterminatus. Apothecia (madefacta diam. ·1 mm.) disco rufo plano, margine tumido subgranuloso albo, paraphysibus non bene discretis apice granosis fuscescentibus, exciopulo thallode pallido gonimico calluloso, gonimia magna. Sporæ ovoideæ 3-loculares, loculis tubulo tenui junctis, incolores, longit. ·024, crassit. ·012 mm.

Ad cortices.

DESCRIPTION OF PLATES XII. AND XIII.

Fig.

1. *Sticta amphisticta*, Kn.
   - *a*, spores.
   - *b*, ascus with spores.
2. *Sticta episticta*, Nyl.
   - *a*, ascus with spores.
3. *Pannaria atro-fumosa*, Kn.
   - *a*, ascus with spores.
   - *b*, granulæ gonimæ.
4. *Pannaria apiculata*, Kn.
   - *a*, ascus with spores.
   - *b*, granulæ gonimæ.
5. *Pannaria triptophylla*, Ach.
   - *a*, ascus with spores.
6. *Pannaria subsimilis*, Kn.
   - *a*, ascus with spores.
8. *Pannaria biatorina*, Kn.
   - *a*, ascus with spores.
   - *b*, two spores.
   - *c*, granulæ gonimæ.
9. *Pannaria subimmixta*, Kn.
   - *a*, spores in ascus.
   - *b*, two nodules with granulæ gonimæ.
10. *Physcia plinthiza*, Nyl.
    - *a*, three spores.
11. *Lecanora babingtonii*, Mass.
    - *a*, ascus with spores and three separate spores.
    - *b*, *Lecanora punicea*, Ach., two spores.
    - *c*, „ „ two spores.
12. *Bacidia subscripta*, Kn.
    - *a*, two spores.
13. *Bacidia glomerulosa*, Kn.
    - *a*, three spores.
    - *b*, granulæ gonimæ in nodule.
    - *c*, granulæ gonimæ.
14. *Bacidia eucoccodes*, Kn.
    - *a*, a separate spore.
    - *b*, granulæ gonimæ in nodule.
    - *c*, ascus with spores.
15. *Bacidia spirospora*, Kn.
    - *a*, ascus with spores.
    - *b*, spore separate.
16. *Bacidia melastegia*, Kn.
    - *a*, ascus with spores.
17. *Bacidia anceps*, Kn.
    - *a*, two spores.
18. *Bacidia cerasentera*, Kn.
    - *a*, spore.
19. *Bacidia melasema*, Kn.
    - *a*, two spores.
20. *Bacidia mesospora*, Kn.
    - *a*, ascus with spores.
    - *b*, spore.
21. *Bacidia stenospora*, Kn.
    - *a*, ascus with spores.
    - *b*, spore.
22. *Bacidia pedicellata*, Kn.
    - *a*, spore.

(Description of Plates XII. and XIII.—continued.)

Fig.

23. *Bacidia rimosa*, Kn.
 a, two spores.
24. *Bacidia carneo-rufa*, Kn.
 a, spore.
25. *Bacidia rosello-carnea*, Kn.
 a, two spores.
26. *Bacidia pseudo-pyrra*, Kn.
 a, ascus with spores.
 b, spore.
27. *Bacidia leuco-carpa*, Kn.
 a, spore.
28. *Bacidia spodoelæina*, Kn.
 a, spore.
29. *Bacidia chryso-carpa*, Kn.
 a, spore.
30. *Bacidia nanospora*, Kn.
 a, spore.
 b, granulæ gonimæ in nodule.
31. *Bacidia pannaroidea*, Kn.
 a, granulæ gonimæ in nodule.
 b, spore.
32. *Bacidia rhodocarpa*, Kn.
 a, ascus with spores.
 b, granulæ gonimæ in nodule.
33. *Bacidia albido-prasina*, Kn.
 a, spore.
34. *Lecidea cerino-carpa*, Kn.
 a, ascus with spores.
 b, granulæ gonimæ in nodule.
35. *Lecidea rhypoderma*, Kn.
 Ascus with spores.
36. *Lecidea parvifolia v. corallina*, Tuck.
 Ascus with spores.
37. *Lecidea microdactyla*, Kn.
 Ascus with spores.
38. *Lecidea conisalea*, Kn.
 Ascus with spores.
39. *Lecidea semipallida*, Kn.
 Three spores.

Fig.

40. *Lecidea albiprætexta*, Kn.
 Ascus with spores.
41. *Lecidea glandulosa*, Kn.
 a, ascus with spores.
 b, granulæ gonimæ in nodule.
 c. ascus with spores.
42. *Lecidea coccodes*, Kn.
 a, ascus with spores.
 b, paraphysis.
43. *Platygrapha macrospora*, Kn.
 a, apothecium, magnified about 40 diameters.
 b, two spores.
44. *Platygrapha myriommata*, Kn.
 a, apothecium, magnified about 40 diameters.
 b, three spores.
45. *Platygrapha mecistospora*, Kn.
 a, ascus, with spores.
 b, apothecium, magnified about 40 diameters.
46. *Verrucaria leptostegia*, Kn.
 a, apothecia, magnified about 40 diameters.
 b. spores in ascus.
 c, spermagonium, magnified about 40 diameters.
 d, spermatia.
47. *Megalospora dispora*, Kn.
 a, apothecium, magnified about 40 diameters.
 b, spore.
 c, ascus with two spores, less highly magnified.
48, *Lecanora homologa*, Nyl.
 a, spores in ascus.
 b, spore.

NOTE.—The figures magnified about 900 diameters, except where otherwise noted.

Art. LVI.—*Notes on New Zealand Plants.* By J. Buchanan, F.L.S.

[*Read before the Wellington Philosophical Society, 21st February*, 1880.]

Mesembryanthemum æquilaterale, Haw.

Baron von Mueller informs me that this species is often found accompanying *Mesembryanthemum australis*, Soland., and may be distinguished by the longer acutely trigonous leaves and pulpy fruit.

Zannichellia palustris, Linn.*

According to Baron von Mueller, there is little doubt that the plant under this name belongs to the genus *Lepilæna*. The difference between *Zannichellia* and *Lepilæna* consists in the male flowers. These may be easily found all the year round in New Zealand at the swollen bases of the leaves, and generally on distinct plants from the female.

Solanum vescum, F. Muell.

Respecting this species, its author states that it may often be found growing with *Solanum aviculare*, Forst. It is a smaller shrub, and is distinguished from the latter by the angular dark-green branches, small entire dark-green leaves, darker coloured flowers, with somewhat different stamens, berries small, roundish, and green, never egg-shaped or orange-colour when ripe. The natives of Australia always avoid the fruit of *S. aviculare*, as poisonous, but eat with impunity that of *S. vescum*.

The following plants have been recently added to the flora of New Zealand :—

Oreostylidium, Berggren, nov. gen.

This genus is founded on a small alpine, *Stylidium subulatum*, Hook. fil., *Handb. N.Z. Flora*, I., 168; placed in that genus by Hooker from imperfect flowering specimens. *Oreostylidium* differs from *Stylidium* in the deeply divided corolla, short erect column, and indehiscent capsule. Habitat in New Zealand, Ruapehu Mountain, Swampy Hill near Dunedin, Invercargill, *Berggren;* Nelson Mountains, *Travers; Haast. Trans. Roy. Soc. Lund*, 1878, *p*. 1.

Abrotanella linearis, Berggren, n. sp.

A larger plant than *A. pusilla* of Hook. fil., *Handbook N.Z. Flora*, I., 139. Scape longer and bracteate. Leaves long, obtuse, spreading. Otira Gorge, Canterbury, 3,000ft. *Trans. Roy. Soc. Lund*, 1878, *p*. 14.

Dracophyllum acerosum, Berggren, n. sp.

Mount Torlesse and Bealy River, Canterbury. *Trans. Roy. Soc. Lund*, 1878, *p*. 15.

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* [For reference to the occurrence in New Zealand of *Zannichellia (Lepilæna) palustris*, Linn., and *L. preissii*, F. Mueller, see papers by T. Kirk, F.L.S., in Trans. N.Z. Inst., III., 143; VII., 508; X. App. xl.—*Ed.*]

Plantago triandra, Berggren, n. sp.

Differs from other New Zealand species in the solitary flowers, which are subsessile in the woolly axils of the leaves. Corolla 3-lobed, sepals minute, capsule scarious, seeds numerous. Otira Gorge, Canterbury. *Trans. Roy. Soc. Lund*, 1878, *p.* 16.

Thelymitra intermedia, Berggren, n. sp.

Bay of Islands, *l.c.*, 1878, *p.* 21.

Kelleria (Drapetes) villosa, Berggren, n. sp.

Distinguished from all its congeners by the ramifying stems and leaves, which are woolly on the back. Mount Torlesse, 5000ft., *l.c.*, 1878, *p.* 18.

Isolepis subcucúllata, Berggren, *l.c.*, *p.* 22.

Cladium complanatum, Berggren, *l.c.*, *p.* 23.

Oreobolus strictus, Berggren, *l.c.*, *p.* 25.

Carex tenax, Berggren, *l.c.*, *p.* 27.

,, *dipsacea*, Berggren, *l.c.*, *p.* 28.

,, *comans*, Berggren, *l.c.*, *p.* 28.

,, *pulchella*, Berggren, *l.c.*, *p.* 29.

,, *cirrhosa*, Berggren, *l.c.*, *p.* 29.

,, *buchanani*, F. Muell., n. sp. MS. This species belongs to the section with 2 stigmas.

Danthonia ovata, Buchanan, *Indigenous Grasses of New Zealand*, plate XXIX., 2.

,, *australis*, Buchanan, *l.c.*, plate XXXI.

,, *pilosa*, R. Brown, var. *stricta*, Buchanan, *l.c.*, plate XXXIII., 1, A.

,, *pilosa*, R. Brown, var. *racemosa*, Buchanan, *l.c.*, plate XXXIII., 2, B.

,, *semiannularis*, R. Brown, var. *alpinus*, Buchanan, *l.c.*, plate XXXIV., 2, A.

,, *pauciflora*, R. Brown, *l.c.*, plate XXXVI., B.

,, *thomsonii*, Buchanan, *l.c.*, plate XXXVI., 2.

Poa foliosa, Hook. fil., *l.c.*, plate XLII.

,, *foliosa*, Hook. fil., var. γ, Buchanan, *l.c.*, plate XLIII., B.

,, *anceps*, Forst., var. ε *debilis*, Buchanan, *l.c.*, plate XLVI., E.

,, *anceps*, Forst., var, ζ *minimé*, Buchanan, *l.c.*, plate XLVI., F., equals *Poa pusilla*, Berggren, *Trans. Roy. Soc. Lund*, 1878, p. 31.

,, *intermedia*, Buchanan, *l.c.*, plate XLVIII., A.

,, *acicularifolia*, Buchanan, *l.c.*, plate XLIX., A.

,, *uniflora*, Buchanan, *l.c.*, plate XLIX., B.

,, *pygmæa*, Buchanan, *l.c.*, plate L., A. *Poa enysi*, Kirk, undescribed, *Trans. N.Z. Inst.*, Vol. IX.. p. 500.

Poa albida Buchanan, *l.c.*, plate L., C. Equals *Poa anceps*, Forst., var. ε *alpina*, Hook. fil., *Handb. N.Z. Flora*, I., p. 339; also *Poa sclerophylla*, Berggren, *Trans. Roy. Soc. Lund*, p. 30, 1878.

„ *mackayi*, Buchanan, *l.c.*, plate LI., A.

„ *kirkii* Buchanan, *l.c.*, plate LI., B. *Poa purpurea*, Kirk, undescribed, *Trans. N.Z. Inst.*, Vol. IX., p. 500.

„ *sclerophylla*, Berggren, *Trans. Roy. Soc. Lund*, p. 30.

„ *pusilla*, Berggren, *Trans. Royal Soc. Lund*, p. 31.

Agrostis æmula, R. Brown, β *spathacea*, Berggren, *l.c.*, p. 32.

Schedonorus littoralis, R. Brown, var. *triticordes*, Bentham, *Fl. Austral.*, VII., p. 655. *Indigenous Grasses of New Zealand*, plate LIV.

Triticum scabrum, R. Brown, var. *tenue*, Buchanan, *l.c.*, plate LVIII., B.

Stipa petriei, Buchanan, *l.c.*, plate XVII., 2.

Deyeuxia scabra, Bentham. *Indigenous Grasses of New Zealand.*, plate XXVI., 2.

Art. LVII.—*On Grasses and Fodder Plants.* By S. M. Curl, M.D.

[*Read before the Wellington Philosophical Society*, 13*th September*, 1879.]

Among the thousands of species of grasses that grow, and are indigenous to various parts of the world, and very many of which are known to possess peculiarities for which they are esteemed in the several localities, how very little has been done to cultivate them and ascertain their merits under careful test culture, upon various soils, and in differing climates. Excepting the few *Poas*, *Loliums*, *Bromes*, *Fescues*, and a small number of others, hardly any of the known grasses have been sown and used by farmers and graziers, in either Great Britain, America, Europe, these colonies, and elsewhere. They have been by so-called practical men entirely neglected, and the few men who have devoted themselves to growing and testing them by scientific methods, are small in number, and yet when we consider the enormous interests involved, this seems incomprehensible, knowing, as we all do, that cattle, sheep, horses, and many other creatures that are used as food, or for draught purposes, are principally dependent upon grasses for their sustenance, and that the better the grass, the more of it and its varieties suited to the several conditions, so will be the increase and perfection of the animals fed upon it, and the greater will be the profit to the persons owning the animals eating these grasses.

When, however, any good grass has been cultivated under favourable conditions, cultivation has developed its merits, and its qualities have been changed, or improved. The *Loliums* (ryes) were originally much less valuable

grasses than at present; they were annuals, or biennials, but from these, Stickney, Pacey, Lawson, and others, by cultivation and management, have produced kinds that they call perennial, and that certainly live on for several years in permanent pastures. The Italians, by carefully saving and sowing the seed under the best conditions, have now established a variety, the seed of which is sold at a high price, and when sown in irrigated meadows, or on sewage farms, gives a yield that is enormous, and so great has been the benefit to British and other farmers, by the improvements made in these two grasses, that without them they could not have produced the same quantity of meat, and could not have obtained a return from their farms and pastures. In America the agriculturists have cultivated and sown some of their indigenous grasses with the greatest profit and benefit to themselves,—the blue grass (*Poa compressa*) in Kentucky; the red-top (*Agrostis rubra*) in the Western States; and the *Phleum pratense* (timothy, cat-tail, etc.), in the Northern States,—and these have been the principal kinds cultivated, although they had such numerous and excellent grasses to choose from.

In the Australian colonies the indigenous grasses, although most excellent ones are found, are gradually being killed out by injudicious burning and over-feeding of stock not allowing them to seed or reproduce themselves by a fair rest, and by other bad management will get less abundant each year, and the grasses now being sown will not beneficially supersede them. A few years since, the *Hierochloe redolens* was one of the best winter fattening grasses in these districts, and the cattle, sheep, and horses, eagerly sought it out, and fed upon it; now it is rapidly disappearing, and what is left the live stock will soon kill out, as each year it becomes more scarce, and so with many other species here, while in Australia we learn from the writings of Mr. Bacchus, Mr. Bailey, and others, that the kangaroo grass (*Anthistiria australis*) which used to appear like fields of corn, so vigorous and abundant was it, has now become stunted and is dying out in many parts, and other species also as well as the kangaroo grass; useless or even noxious weeds are taking the places vacated by the nutritious grasses, yet to prevent such disastrous consequences following the reckless destruction of the indigenous grasses, either these grasses should have been fairly treated, or other suitable ones should have been substituted; and there are numbers which could be with advantage sown as can be easily proved. For whenever we understand the full history and description of a grass growing in any place, or where we can grow and test a grass under experimental culture, it is not difficult to predict and describe its worth. When friends of mine in California desired my advice and assistance to find a grass that would bear the climatic conditions of the hot, dry climate of California, I

sent them seeds of the *Panicum spectabile* and other suitable grasses; and confining ourselves to the growth there of this *Panicum*, Professor Sanders writes to the "Pacific Rural Press" saying: "I need now only speak of the roots of the *Panicum spectabile;* a single seed will in one season produce a mat or tussock of stems forming a bunch a foot or more in diameter. From this extends a mass of roots or underground stems. As soon as frosts stop the growth of the top the roots seem to grow with accelerated vigour. At this season (February) of the year many of them are as large as a man's finger, and some of them are a dozen feet in length. They are white, tender, and very juicy, looking somewhat like blanched asparagus stalks. They are far too scarce yet for me to test their economic value as food for hogs, but I have great faith in them. It grows from 3–5 feet in height, and is so dense one can hardly force his way any distance through it." And when they wrote to me from Queensland that they wanted some grass to stand close feeding, and that would not die out, I sent them some of our New Zealand couch; and having tested it, they write to say it is the very thing for their purpose, as they have nothing like it for feeding stock. And the same kind of testimony comes from any part of the world where they will sow the appropriate grasses, and give the proper treatment.

In all countries there are to be be found growing grasses that are not only useful in the place where they are native, but they may be beneficially introduced to all appropriate localities to increase the amount of feed upon each acre of pasture land.

In this country many of the indigenous grasses are of excellent quality, and it is a very great mistake that they are not carefully cultivated, and the seed sown in the meadows amongst other kinds; and now that the labours of Dr. Hector and Mr. Buchanan and others have by their truly admirable work, both literary and pictorial, on the New Zealand grasses—a work which reflects the greatest credit on its compilers, teaching all easily to learn the merits of the indigenous grasses—it will be well for the farmer and grazier to collect seed and cultivate it, and, having done so, to sow it in proper localities.

The Queensland Government has, also, published a most excellent illustrated work on the native grasses of that colony, being some of the results of the most useful and scientific labour of Mr. Bailey and others in their investigation of the causes of disease in live stock, and the cause of the grasses disappearing. The Queensland Government are taking the best possible means to benefit all true colonists, as if they succeed in arresting the dying-out of the native grasses, and introducing the most suitable exotic kinds, no efforts could be directed to a more useful purpose.

In these new countries we do not know how good many plants may be until they are properly tried, and it is only by actual experiment that we

can be sure of the merits of such proposed introductions, but all the labour, expense, and trouble of numbers of introductions may be repaid by only a few things that turn out to be really useful and worthy, and in grasses this has been proved especially to be the case, as those grasses mentioned in my former papers to this Society will show, and yet there remain very many amongst the hundreds I have sown and experimented with that show they would be very useful if sown by the farmers and graziers to increase the feed in their pastures.

I purpose to add, before concluding this paper, some other grasses to those before described that are desirable to cultivate to increase the herbage for the places and times indicated.

When it is remembered how vast are the interests that are involved in keeping up the pastures to the best possible condition, it seems marvellous the little interest that is taken, by even farmers or graziers themselves, in grasses and grass-culture; so long as a little rye-grass seed and a little white clover seed is scattered over the field—they are satisfied. The live stock is then turned out, either to kill it by over feeding-down, or, by constantly trampling over the grass and ground, to reduce its power of growth to the lowest, and then finally to kill it. This is all the knowledge and care taken about the matter; but it is soon seen how little stock can be kept to the acre by such plans, and how impossible it is that land can be profitable under such treatment when used to depasture animals upon.

It is put forward by some persons who have not fully considered this question, that foddering or stall-feeding, or shutting up the live stock and supplying them with all their food, which must be specially grown for them by hand, is the most advantageous course to pursue, but except under very peculiar circumstances this is impossible. It becomes a question of cost of production, and the meat markets of the world regulate the profit or loss upon this matter. Even in Great Britain, with cheap labour and a full knowledge of how to produce the greatest amount of fodder at the cheapest rates, the cost is so great that meat has risen to an almost prohibitive price; and now the Americans, taking advantage of their large grazing fields, where grass is at present abundant, because the population to the square mile is small in numbers, are pouring in meat to the British markets, and making it impossible fer the men who are hand-feeding their animals to compete with them. If, therefore, meat production will not bear the cost of hand-feeding of live stock in Great Britain, where the meat consumers are numerous and labour for feeding cattle cheap and abundant, it certainly will not pay to hand-feed in this colony where all these conditions are different. As a large proportion of this population must gain their means of living by meat and wool production, it follows that they must

devote themselves to studying and working out the best means of grazing the largest quantity of live stock the area can fairly and profitably carry.

Instead of allowing the sheep or cattle to roam over the whole of the pastures at once, destroying more food than they eat, and searching for the small patches of grass they prefer the taste of and neglecting the others, it will be necessary to divide the land into small hedge-enclosed paddocks, and by putting in a sufficient quantity of animals, cause them to eat the whole of the grass in a few days, and then remove them all into the next inclosure, and give the one they leave a rest, long enough for the grass to grow up healthily, before the stock are placed upon it again. And as there is often a difference in a very short distance in the chemical constituents of the soil and subsoil, in the wetness or dryness of the soil or subsoil, of the flat or hilly character, of the easterly or westerly exposure—giving it earlier or later sun-light impact (for it is well-known to scientists that the angle of incidence with which sun-light is able to strike land will materially alter its power of growing differing plants), the exposure or otherwise of the several pieces of land to prevailing winds, its mechanical condition of looseness or cohesion, and its condition of tillage,—these, and many others, will enable the man with knowledge to choose the right kinds of grasses to sow down on his several enclosures, and then by sowing as many of the proper kinds as possible upon each enclosure, the live stock will meet with a constant change of food, and will thus thrive and come to maturity at the earliest date, and give the largest return for the invested capital. And as neither animals nor plants can live without suitable chemical elements are supplied to them, and as the different species of grasses take up and assimilate different quantities and qualities of chemical elements, so the animals fed upon ground carrying such grasses can thus readily obtain the material they require to build up their tissues and organs. Again, each species of grass has its own particular season of greatest perfection, some in the summer, some in the winter, others in the spring, and others in the autumn, and the seasons of greatest growth also very materially differ; for while the *Briza*, *Alopecurus*, and the *Anthoxanthum*, are growing fastest in spring, and certain of the *Panicums*, *Andropogons*, *Anthisteria*, etc., in summer; the *Fescues* and *Phleums*, in autumn; the *Poas*, the *Bromes*, and others in winter—therefore, the latitude, elevation above sea level, and many other conditions, will regulate the species and varieties of grass to sow; but as there are such numbers to select from in the numerous grasses of the world, there will be no difficulty found in choosing a large number of the best kinds for all sorts and conditions of pastures. Not only is it well to get grasses and fodder plants from other countries, and endeavour to grow and acclimatize them here, but to select the finest seeds from the best

plants, and thus by careful selection secure the finest varieties; but, also, it is well to choose some that are earlier, or later, or hardier than others, and by sowing these kinds, and saving the seeds from the earliest, latest, and hardiest of these again, gradually to work up to a standard of excellence that the original did not possess, and, by continuing this process, after a time a variety will be attained that will possess and maintain a distinct character, and be perpetuated as a distinct kind or race.

By this process are plants acclimatized, and those that at first are with difficulty cultivated, or even made to grow in a locality, are, in successive generations, after a careful selection of their seeds and plants raised from these seeds, brought to adapt themselves to the climate and conditions of their new home, and it is my experience that thus grasses and other plants may be not only acclimatized here, but their characters may be changed in the directions that the experimenter may wish or see desirable. But in spite of the assertion of those who do not know what can be done, "That acclimatization is impossible," and "that it is impossible to change the character of plants;" in this, and other respects, we have only to remember the hundreds of plants that are now growing in Europe and America, that came from very different climates, and how greatly they have been changed and grown into the numerous varieties and kinds at the will of the gardeners, orchardists, and agriculturists, who have taken the trouble and time to establish a new race or variety of grass or other plants possessing particular excellence.

We will now proceed to consider the special merits of a few more kinds of grasses that may be advantageously grown in New Zealand, distinguishing those that are most suitable for culture in the summer only, or at that season being most useful by their more vigorous growth while the hot and dry season lasts, and which, introduced into the northern parts of these islands, will maintain their verdure and vigour while other grasses are parched up with the heat and drought.

I will also point out a few others that have proved themselves hardy enough to be introduced into the South, and that I have found will grown during the autumn and winter, when the summer grasses are at rest, or have ceased to be so nutritious.

Andropogon montanus.—This fine grass during the summer is one that the cattle, sheep, and horses much relish, it is a good grass here during summer and autumn, and in northern districts it has a longer season than further south; it should be sown by all graziers in warm climates where grass not suited to such climates will be useless.

Euchlæna luxurians, the teosint or reana grass.—Having tried this magnificent grass for two years, it appears to promise to be a grass that, in

warm, dry situations, will give more herbage to the acre than anything else, where the climate suits; but it would be better suited to cut for hand-feeding than for the live stock to graze upon it. It grows in warm sheltered situations from 12–15 feet high, and quickly forms a plant 4–6 feet in diameter, while its stems are not so tough and coarse as maize, but green and succulent in all parts. It will be found very valuable in northern districts more than in southern ones, but it is more adaptable to situations of lower temperature than would be thought from its appearance, and from the fact that it is a native of Mexico and adjoining places.

Festuca rubra.—One of the best of the fescues, as its foliage is readily eaten by sheep or cattle; and as it grows on into the cool season, and in sheltered spots through the winter, it is a good addition to mixed pasture.

Festuca dives.—This magnificent grass, which I received from Australia and from several correspondents after some trouble, as its seeds are often unfertile, was, at length, obtained as live plants; and, by division of roots and careful attention to seed, I was enabled to propagate, increase, grow, and test its value; and it is one that, when once by careful selection a variety is obtained, will perfect its seeds. No better grass will be found by the grazier or pastoralist, as its period of growth is so long that summer and winter it is growing here, and as it is a very fattening grass it deserves to be planted extensively.

Echinochloa zenkowski.—Having received seeds of this grass from several parts of the world, I find there are several varieties thus named, some of much more vigorous habit than others; but they all grow rapidly, are relished by stock, and from the great abundance of seed they bear quickly, spread, and cover the ground.

Mountain grass of California.—A grass was sent to me by Mr. Mavity of California, under this name, to test and experiment with, as it was considered, by those who knew it, a good and useful grass. Having subjected it to test culture, I am able to speak very favourably of it. It is a brome grass of very hardy habit, and will grow upon the poorest clays, stand both wet and dry climates, continues to grow and send up its stems for the greater part of the year when not grazed down too closely; its foliage is darker in colour than most bromes. It is much relished by the live stock, and it is in every way a valuable addition to our grasses for permanent pasture, and may be sown with advantage over a wide range of climate.

Panicum maximum, or Guinea grass.—This grass, which grows so vigorously in the hottest weather, ceases to make so much herbage when the autumn is getting cooler, but in the hot northern portions of the colony it is a very suitable grass for quickly fattening the animals fed upon it, and they are very fond of it, especially cattle and horses. In the

southern and cooler parts it only grows in the summer, and rarely continues to grow sufficiently fast to be of service in mixed pasture.

Panicum parviflorum.—A good grass in spring, summer, and autumn, when it is greedily sought for by sheep and other animals, and if fairly treated will greatly add to the yield per acre if sown in a mixture of grasses.

Panicum virgatum is a good grass for the Northern Island of New Zealand, and will hold its own against other quick-growing grasses; and as live stock thrive upon it, it may be recommended as a pasture mixture.

Poa compressa, or blue grass of the Central United States of America, is a rapid-growing, valuable pasture grass, grows at all seasons of the year, and quickly forms a thick turf, but, as it is difficult to eradicate, it is not well to sow it on any place that is not intended for permanent pasture.

Poa chinensis.—This admirable pasture grass, which grows very rapidly in the summer and autumn, and also in the winter although not so vigorously, is a good fattening grass, grows from two to three feet high, relished by stock, but does not perfect much fertile seed in this climate.

Poa sempervirens is a valuable grass, as it grows on throughout the year with less regard to changes of temperature than most other grasses, and it is one of the best *Poas* to sow with mixed grasses, as its constantly green herbage and vigorous power enable it to withstand the trampling of stock and constant feeding of its nutritious foliage.

Poa brownii, or *Eragrostis brownii.*—A very excellent grass to add to our pastures, as it is very good to fatten cattle, grows in any soil and keeps growing all the year round, remaining green.

Panicum crus galli.—A fine and succulent grass, would be found useful on moist land and by the side of watercourses. As it has a creeping habit, it would not be advisable except in land intended for permanent pasture.

Panicum ciliare.—This is a hardy grass, deserving of greater use for pasture, as it has fattening properties and is liked by cattle, and I think would be advisable as a mixture with other grasses.

Danthonia racemosa.—This grass, by test cultivation, is found to be hardy, with fine nutritious qualities, and bears a heavy amount of stock-feeding upon it, suffering less than most grasses. It also holds its own amongst rye, clover, and other grasses; so deserves to be more generally known.

Festuca hookeriana.—A perennial grass of excellent character, and well-adapted for the climate of New Zealand. It grows here above 2 feet high, and produces a quantity of herbage.

Festuca heterophylla.—This grass likes a dry soil, and as it is growing at all seasons of the year might be sown with advantage.

Festuca loliacea.—A grass much to be recommended for marshy lands or river-flats. It produces a good quantity of highly nutritious herbage,

grows from 2 to 3 feet high, and will grow on lands that other grasses cannot thrive upon.

Avena elatior.—This grass grows through the spring and autumn most strongly; and as stock appear to select it in preference to rye, and as, upon analysis, it is found to contain a fair proportion of easily assimilable elements, it should be sown in mixed pastures. It may be sown both in the northern and southern districts; provided the soil is not too dry, it will succeed as a good useful grass.

Melilotus leucantha, or Bokhara clover, is a hardy biennial, growing 8 feet high, and yielding an enormous quantity of herbage for hay or fodder. All stock eat it readily; but it should not be sown too thinly, as it then grows much higher and the stalks become woody, and the stock do not relish it so much. As it is only a biennial, it is best for alternate husbandry.

Symphytum asperrimum, the prickly comfrey, still continues to grow and yields plenty of leaves from the roots before described. All kinds of stock like, and thrive upon it.

Sorghum vulgare is a splendid grass, which, under different local names and in different varieties, is now engaging a very large amount of attention. As I have obtained and grown these several varieties of *Sorghum*, and tested their powers and merits, I will give the result of my experience:—From California, Egypt, India, Southern Europe, and elsewhere, I obtained seeds of these *Sorghums*, and found that those obtained from warmer climates than this were delicate at first, and took some trouble to get them to perfect their seed, but that, by the second or third sowing, the acclimatization had so far progressed that the germination commenced in the open ground the first warm weather in October, and continued to grow during the summer, and perfected seed during autumn, in some varieties giving two crops of seed, the first heads being gathered as soon as ripe, and the second then ripening faster. The varieties that seem to do best in this climate are hereafter described by the local names that they are generally known by in other countries.

The Egyptian Corn is a brown-seeded *Sorghum*, now much cultivated, with heads drooping downwards, and that grows very rapidly, producing an immense quantity of succulent stems and foliage that makes an excellent food for animals, which, cut green, will yield many tons of fodder to the acre, and will, if allowed to ripen its seed, yield a larger weight of corn than most other plants to the acre, having in several instances given over 10lbs. to each plant, or 100 bushels of cleaned grain nett per acre. This grain is eaten by animals, and in Egypt and India by men, cooked and eaten in various ways.

The Durra, or *Doura*, is a white-seeded *Sorghum*, whose seed-heads droop downwards, which is rather less hardy than the brown-seeded variety, but

which grows a very large quantity of nutritious herbage to the acre, in rich land often as much as forty tons to the acre, which will feed milking cows, fattening bullocks or sheep, horses and other animals, or if allowed to ripen its seed will yield a great quantity, often ninety bushels of clean grain to the acre, which will grind into a white flour that is much used in India, California, and elsewhere.

Sorghum halepensis is a white-seeded kind with heads that remain upright and do not droop; this is an excellent sort for saving for ripe corn, and when ground into meal its white flour is of good colour and taste, and contains those elements that mark it out as a valuable food-plant. In China and other parts of Asia, where it is grown, it is considered a valuable cereal; and I think would be a valuable plant both for its corn, and also as a fodder plant, as the domestic animals will eat it green or dried.

Sorghum saccharatum.—The several varieties of this grass that I tested from various parts of China, Thibet, and other parts of Asia, were more or less hardy at first, and the first growths contained different quantities of sugar in their expressed juice and in their tissues, as proved by either fermenting and calculating the distillates of alcohol, or testing them by chemical re-agents; but after a few years sowing their hardiness increased, or they adapted their growth more to our seasons and climate, while the amount of sugar they developed, showed that many of them were most valuable fodder plants, and would rapidly fatten animals, either cut green, or when preserved in pits, or silos, and that the enormous quantity of herbage per acre they produced, would repay the trouble and labour taken to grow them, by the meat and milk they would produce.

Broom Corn.—A variety of *Sorghum vulgare* produced by selective culture in America, can be grown here and furnish the broom-makers with the parts they require, that is the expanded panicle; both the large and dwarf varieties ripened seed with me, but as they are not so excellent as a fodder plant as some other varieties, and although pigs, fowls, and other domestic animals eat the seeds, yet the other varieties are better for the meat and milk producer.

A variety of Imphee, called *Red Imphee* or Siberian perennial, grows well during the hot weather, and being hardier than the other Imphee, may be recommended, as it gives a large quantity of fodder during the summer and autumn here, and will be even better further North.

The hardy sugar-cane, developed and grown in Minesota, and called "*Kennedy's Amber Minesota,*" grows well as a fodder-plant here, and the quantity of saccharine in it makes it much relished by live stock, and soon fattens them; while the farmers can obtain a syrup from its juice which will answer the purposes to which sugar is often applied, and in the warmer

parts of this colony, I have no doubt, this cane would be a most useful plant, both for live stock and for its sugar-bearing qualities, which might be utilized in many ways.

The *Penicillaria spicata*—East Indian pearl millet grows here during the hottest and driest weather, and gives from each root a very large quantity of herbage, as it grows several feet high and 3 feet in diameter. For the north of this island, where other plants will not grow, it is most valuable. Either cut green, or made into hay, it has been known to produce during the year, when cut several times, 9½ tons of dry hay to the acre, which was quite tender and sweet, and readily eaten by the cattle.

The *Cobbet-corn*, or forty-day maize, is very hardy and prolific; although a dwarf kind of maize, it can be sown more closely than the taller-growing varieties, and ripens its corn and arrives at perfection in southern localities where the other kinds do not so easily ripen. It can be saved for its seeds, which horses readily eat, or cut green for fodder, or put away in silos and fed to the live stock in winter. It has proved itself a very quick grower, and ripened well with me.

The White-dent Corn.—A valuable maize of the best kind to grow for domestic use, as being semi-transparent, white, hard, and of good flavour; its flour, when grown, is good for private use or export; after its cobs are removed its stalks and dry leaves are readily eaten by live stock.

Rice Corn.—A small variety of maize that yields a pretty little transparent grain, that may be ground into a good flour, or the whole plant may be given to live stock, either green or dry.

Sugar Corn.—Several varieties of maize under this name were obtained from America and elsewhere, and grown. There are several of these varieties well worthy of introduction here as fodder-plants, as they contain a large percentage of sugar. When their cobs have formed grains somewhat hardened, they are best to be cut at this period, as, if then either fed to animals green, or placed in silos according to the French plan, and well trodden down, and covered so that the air is excluded, they may be cut out in the winter, and animals then rapidly fattened and thus got ready for the butcher, when, by reason of the temperature and want of other herbage, very few fat stock are obtainable.

In America the cobs of these sugar corns are gathered while soft, or before fully ripe, and cooked and eaten, and if any one will try the experiment they will find this an excellent vegetable.

The *Sweet Corns* are other varieties of maize not having quite as large a proportion of sugar as the sugar corn, but are very useful.

The above-written are the grasses and fodder-plants that carefully-conducted experiments have proved to me can be grown in New Zealand

with advantage and profit to the graziers and farmers. The results of investigation only are given. As to detail, the course of experiment would take up too much time and space, as the growth, analysis, and experiments in succeeding years, of each particular grass would occupy more than the whole of this paper, and the end would be that only a very few men devoted to scientific methods and pursuits would care to follow the history of experiment of each grass in my different experimental plots in the several localities where my stations or grounds are situated; but by giving the results, and pointing out the suitableness of a particular grass or fodder-plant, these results may be turned into money by those who may select and grow these plants for the feeding of stock on their pastures or farms, while by bringing these results before this learned Society, composed of men engaged in so many different pursuits and living in so extended an area, the knowledge of new and suitable plants to give increased feeding-power, will through this Society be brought to the knowledge of a very extended body of colonists, who will be able if they please to practically and profitably apply this information.

Art. LVIII.—*Descriptions of new Flowering Plants.* By T. Kirk, F.L.S.

Plate XIV.

[*Read before the Wellington Philosophical Society, 21st February,* 1880.]

Ranunculaceæ.

Ranunculus depressus.

A small matted species with long straight hairs on scapes and petioles; stem simple, rarely giving off short, stout scions in the autumn. Leaves all radical, on rather long petioles, 1″–1½″ long, depressed, spreading, broadly ovate in outline, trifoliolate, leaflets 3-toothed or lobed, or pinnatisect; segments linear, obtuse. Scapes solitary, stout, inclined, simple, 1-flowered, much shorter than the leaves, ¾″–1″ long, sepals 5 membranous, petals 5 spreading, with a small gland near the base. Carpels hidden amongst the leaves, 3 or 4, turgid, with a minute beak.

Hab.—South Island: Trelissick, Canterbury, in bogs, 2,000 feet.

I had the pleasure of discovering this plant in the winter of 1876, and am indebted to Mr. J. D. Enys for flowering specimens. Its nearest ally is *R. sinclairii*, Hook. f., from which it is distinguished by the turgid achenes, and scapes shorter than the leaves. The leaves are broader and shorter in outline, sometimes nearly entire, but when divided the segments are always longer than those of its ally. The root stock is always erect and very short,

while it is less stout than that of *R. sinclairii*, from which it is further distinguished by its singular habit.

Occasionally the leaves are reduced to three linear segments.

Ranunculus enysii.

Glabrous in all its parts. Leaves all radical, on long slender petioles, 3″–6″ long, 3–5-foliate, leaflets on slender pedicels, tripartite or nearly simple, segments cuneate, trilobate, toothed, teeth acute, margins thickened. Scapes 3–5, naked, simple, 1-flowered, 5″–12″ long, or rarely with a solitary branch springing from the axil of a reduced leaf. Flower ¾″ in diameter, sepals 5, broadly ovate acute. Petals 5–10, broadly obovate. Achenes small, in dense globose heads, glabrous, ovate, with a short slender curved beak; testa minutely reticulate.

Hab.—South Island; Trelissick, Canterbury, 2–3000 feet—*J. D. Enys.*

Very different in appearance from any other New Zealand species, although in some respects it approaches the typical form of *R. lappaceus*, Sm., the styles, however, are never recurved, and the carpels are not keeled, as in that species; the heads are more truly globose, and, with the glabrous highly-divided leaves, afford subordinate distinctive characters of some importance. The rounded carpels distinguish it from *R. plebeius*, Br., and the minute curved styles from *R. geraniifolius*, Hook. f.

LEGUMINOSÆ.

Carmichælia williamsi.

A leafless shrub. Branches excessively compressed, ⅜″–⅝″ broad, thin, with numerous parallel grooves, minutely pubescent when young, hoary, or silky; notches alternate, distant. Leaves unknown. Flowers sparingly produced, solitary or 2–3-flowered fascicles, very large, with the pedicels fully 1″ long, pedicels slender, silky. Calyx large, 5-toothed, acute, pubescent; corolla sharply curved upward, petals acute; stamens diadelphous; ovary shortly stipitate, glabrous; style long, curved, stigma capitate. Pod unknown.

Hab.—North Island: Raukokore Bay, Bay of Plenty, Hicks' Bay—*Archdeacon W. L. Williams.*

This fine species, in all respects the largest of the genus, is allied to *C. nana*, Hook. f., in the structure of the flowers, but entirely lacks the rigidity of that species. It will be interesting to learn if it resembles its ally in the turgid pod.

The branches are very thin for so large a plant, the notches are more distant than in any other species, and in the young state carry a single triangular scale, exactly as in *C. nana*, but in old branches the single scale is replaced by an aggregated mass of shorter scales, sometimes attaining the size of a small pea. The upper part of the vexillum forms a right angle

with its base; the alæ are almost equal to the vexillum in length, but rather narrow; the carina is sharply curved, both segments being coherent for their entire length. The flowers appear to be of a lurid red colour similar to those of *C. nana.*

I am indebted to the Venerable Archdeacon W. L. Williams for specimens of this and other rarities; it affords me especial pleasure to associate his name with so fine a plant as a mark of appreciation of the unobtrusive services he has for many years rendered to botanical science in this colony.

Compositæ.

Senecio compactus.

A much-branched compact shrub rarely more than 2 feet high. Branches stout, erect, and with the under-surface of the leaves, pedicels, and involucres densely covered with appressed white tomentum, forming a smooth surface. Leaves petioled, ascending, $\frac{3}{4}''$–$\frac{1}{4}''$ long, ovate or obovate, obtuse, minutely waved at the margin, crenulate. Flowers in leafy 4–8-flowered racemes, terminal and solitary, or axillary and crowded near the ends of the branches: less frequently the heads are solitary and terminal. Heads broadly ovate in bud, $\frac{3}{4}''$–$1''$ in diameter, broadly campanulate, pedicels $\frac{1}{2}''$ long, involucral leaves, linear, obtuse cottony; receptacle flat, rays spreading broad. Achenes furrowed, silky, pappus white.

Hab.—North Island: Castle Point, East Coast, on limestone rocks, descending to sea-level. This handsome species is remarkable for its dwarf compact habit, although rarely exceeding 2 feet in height it attains a diameter of from 3 to 6 feet, and as nearly all its crowded branchlets are terminated by flowers it presents a most attractive appearance.

Its nearest ally is the alpine *S. munroi*, Hook. f., which is found at an elevation of from 1500 to 4000 feet in the north-eastern portion of the South Island; in sheltered places attaining the height of from 6 to 10 feet. It differs from the present species in the very small receptacle, turbinate heads, slender pedicels, glandular paniculate inflorescence, narrow membranous involucral scales, longer narrow spreading leaves, and slender habit.

In *S. compactus* the inflorescence is never glandular, nor paniculate; the receptacle is much larger than *S. munroi*, and the rays are twice the width. The tomentum, also, is much more copious, and milk white; at once attracting attention to the plant, which is not the case with *S. munroi.* The leaves of the latter are evidently reticulated beneath, which is not the case with *S. compactus*, in which the tomentum presents a smooth even surface.

This species attains its maximum of flowering about the middle of February, but a few flowers are produced nearly all the year round. I first observed it during the winter of 1877.

Scrophularineæ.

Euphrasia disperma, Hook. f.

***E. longiflora*, Kirk, in Trans. N.Z. Inst. XI., p. 440.**

***E. (Anagosperma) disperma*, Hook. f., Ic. Pl., t. 1283.**

PLATE XIV.

Stems weak, procumbent, matted, 2″–4″ long, clothed with deflexed, often glandular hairs. Leaves small, $\frac{1}{6}''$–$\frac{1}{4}''$ long, opposite, shortly petioled or sessile, lanceolate, acuminate, 3-nerved, margins entire. Flowers solitary, axillary, on short curved pedicels, erect. Calyx deeply 4-cleft, teeth linear acute. Corolla erect, $\frac{1}{2}''$–$\frac{3}{4}''$ long, tube narrow at base, dilated above, upper lip erect, obcordate; lower lip projecting, 3-lobed, lobes equal. Stamens 4, anthers large, exserted, acute. Stigma circinate at the apex. Ovary broadly ovoid, 2-celled, cells 1-ovuled, ovules pendulous from the top of the ovary. Capsule (immature) oblong, slightly beaked, apparently indehiscent.

Hab.—South Island: Okarito—*A. Hamilton.*

In Trans. N.Z. Institute, Vol. XI., I provisionally described this singular little plant under the name of *Euphrasia longiflora*, but before the publication of that volume it was described by Sir Joseph Hooker under the name given above. I have therefore given a fuller description, although still imperfect, as the ripe fruit is unknown.

This species is related to *E. repens*, Hook. f., which at present has only been found at the Bluff. *E. disperma* is distinguished from all its congeners by the 1-ovuled cells, while its narrow erect corolla and entire leaves are prominent characters.

Respecting *E. repens* and *E. disperma*, Sir Joseph Hooker writes in "Icones Plantarum:"—"The fruit is known in neither of these species; if indehiscent in both, they would form a genus instead of a subgenus, under which I now place them with the name *Anagosperma* from the reduced number of seeds." He further states that *E. disperma* is distinguished from all other *Scrophularineæ* by its solitary ovules.

Thymeleæ.

Pimelea haastii.

A strict low-growing shrub 6–10 inches high. Branches few (?), very slender, white with silky hairs. Leaves in distant pairs, petioled, ascending, narrow lanceolate, $\frac{3}{4}''$–$1\frac{1}{4}''$ long, acute, hairy below, or nearly glabrous, margins recurved; floral leaves similar. Flowers 5–8 in a head, very small, perianth swollen below, sessile, silky, lobes narrow, spreading; filaments short; style equalling the perianth tube. Fruit not seen.

Hab.—South Island: Canterbury Alps—*Professor von Haast, Mr. Armstrong.*

Although this plant appears very different from any other New Zealand form it is difficult to lay down satisfactory characters apart from the foliage

EUPHRASIA DISPERMA, Hook. fil.

J.B. lith.

and remarkable habit, in both of which it differs widely from its congeners. It is most nearly related to *P. virgata*, Vahl., but differs in the distant, erect leaves, which are broader and less acute than in that well-known species. In its slender habit and distant leaves it approaches the Tasmanian *P. filiformis*, but the flowers are very different, and the stems although extremely slender are not flexuous.

Two or three small specimens of our plant are preserved in the Herbarium of the Canterbury Museum, and were collected during Dr. Haast's earlier exploration in the Southern Alps. The precise habitat is unknown, but there is reason to believe that they were collected in the vicinity of the Porter River. I have received small specimens from Mr. Armstrong, marked, "habitat unknown," but probably obtained from the same locality as those of Professor von Haast.

DESCRIPTION OF PLATE XIV.

Euphrasia disperma, Hook. fil. Natural size.

1. Flower. 2. Anthers, back and front. 3. Stigma. 4. Longitudinal section of ovary. All enlarged.

Art. LIX.—*Description of a new Species of* Cladophora. By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 21st February,* 1880.]

Tufts irregular, entangled, green; filaments capillary $\frac{1}{2}''$ to $\frac{3}{4}''$ long, flexuous, sparingly branched, branches spreading, with wide axils, dichotomous or alternate; articulations four to six times as long as broad, cylindrical, dissepiments slightly constricted.

Hab.—South Island: Okarito. Forming woolly-looking tufts on the rhizomes of *Trichomanes colensoi—A. Hamilton.*

Art. LX.—*Notice of the Occurrence of* Lagenophora emphysopus, *and other unrecorded Plants in New Zealand.* By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 21st February,* 1880.]

Lagenophora emphysopus, Hook. f.

This plant was brought under my notice as a native of the colony by Mr. W. H. Field, a student of Wellington College, who discovered it on hills near Evans Bay; shortly afterwards it was obtained at Paikakariki by Mr.

H. B. Kirk; and I had the pleasure of collecting it in a third locality, near this city. The following are its chief characteristics:—

Root of stout fleshy fibres. Leaves all radical, tufted, oblong or obovate, obtuse, narrowed at the base into a short broad petiole, obscurely toothed or crenate; hirsute or pubescent. Scapes numerous, stout, grooved, hirsute, longer than the leaves, usually constricted immediately beneath the head, ebracteate, or with a short leafy bract. Head 2–3 lines in diameter; involucral scales obtuse, with membranous margins. Ray florets scarcely longer than the involucral scales, always (?) tubular. Achenes of the ray flattened, glabrous, narrowed at both ends; of the disc abortive.

This species approaches *L. lanata*, Hook. f., in its general characters, but the heads are even less conspicuous than in that species, the florets being much shorter and the scapes very stout.

Our plant differs from Australian specimens in the scapes being much longer than the leaves, and in the ray florets being always tubular, at least in all the specimens I have examined. Bentham describes the ray florets of the Australian plant as "tubular in bud, but opening out into a short concave 2 or 3-toothed ligula." I have not met with any trace of a ligula, but it should be mentioned that all my specimens were collected very early in the season.

It is the *Solenogyne bellioides*, Sond., of Baron von Müeller's Illustrations of the Plants of Victoria, t. 37.

Vittadinia australis, A. Rich., var. *dissecta*.

In April, 1873, I observed this plant in great abundance by roadsides and in rocky and waste places about Nelson, but during recent visits have been unable to obtain a single specimen even, the plant having apparently died out in the localities where I had gathered it. Two years ago, however, Mr. Cheeseman discovered it in great profusion in a new locality on the coast north of Nelson, extending towards D'Urville Island, and last month I collected it in the North Island, at the shingly mouths of small streams discharging into Palliser Bay, between Watirangi and Cape Palliser. It is doubtless an introduced plant, but will probably be able to maintain its position on loose soils and amongst shingle.

It attains the height of from one to two feet, and differs from the typical *V. australis* in its strict, erect habit; tripartite leaves with narrow 3-lobed segments, and densely-crowded, corymbose flowers, with more or less revolute purple ray florets.

Altogether it presents a widely different appearance from the typical form, and should, I think, be regarded as specifically distinct.

Mesembryanthemum æquilaterale, Haw.

During a visit to Castle Point, I had the pleasure of collecting this species, and now record its occurrence as an addition to our Flora. At first

I was under the impression that I must have overlooked it in other places on account of its similarity to *M. australe*, Sol., but on examining numerous localities in which that species is plentiful, I find no trace of *M. æquilaterale*, which may possibly prove to be local with us, although of wide distribution in Australia.

M. æquilaterale does not appear to descend to the sea-level, or to grow in places exposed to the sea. So far as my observations extended, it was restricted to sheltered places nowhere below 250 feet above sea-level, and never mixed with *M. australe*, which was abundant on the exposed face of the rocks.

In general appearance our plant resembles *M. australe*, but is distinguished by the winged fruit and peduncles; the latter being twice or thrice as long as the leaves, which, in my specimens, are not quite so stout as those of *M. australe*. The immature fruit is never obviously warted as in that species.

I append a description :—

Stems prostrate, stout, 1–3 feet long. Leaves opposite 1″–2″ long, fleshy, linear, triquetrous, or compressed, acute, glabrous. Flowers on long peduncles, terminating short branchlets, or axillary, peduncles twice or thrice the length of the leaves. Calyx tube fleshy, turbinate, $\frac{3}{8}$ of an inch long: lobes 5, unequal, two much larger than the others, fleshy, produced along the calyx tube and peduncle forming a prominent wing. Petals spreading, white or pinkish purple. Styles about 8. Fruit (immature) punctate, with two prominent wings.

IV.—CHEMISTRY.

Art. LXI.—*On certain Results obtained upon some of the Argentiferous Salts which are affected by Light.* By William Skey, Analyst to the Geological Survey Department.

[*Read before the Wellington Philosophical Society, 11th October*, 1879.]

It may be known, although I can get no direct intimation of this, that iodide of silver, like the chloride, requires the presence of water or its constituents ere photographic effects can be induced upon it; but, whether or no, a description of the results which I have obtained in connection with this point will be, I think, of some interest to you, and I therefore give one, and attach thereto a statement of other results obtained with these substances bearing upon the mode in which this photographic effect is produced:—

1. Iodide of silver is not photographically affected even by direct sunlight, if it is kept the while at a temperature approaching to 100° C.; the presence of water or aqueous vapour here does not affect the result.

2. At a temperature of 100° C., and in presence of water, chloride of silver, on the other hand, darkens—though but slowly—in direct sunlight. In aqueous vapour, at about 160° C., it does not darken.

3. A strong aqueous solution of sodic-chloride in contact with these silver salts renders them impervious to the action of light, even at common temperatures.

4. At a temperature approaching 100° C. photographic effects produced upon argentic-iodide are obliterated.

5. A considerable quantity of pure argentic-iodide, after being stirred in the light till it became of a light colour, did not either lose or gain in weight thereby,—that is, appreciably to me. At 100° C. its colour became a full yellow, relapsing to a pale tint when cooled to a common temperature.

6. The product of sunlight upon even pure argentic-chloride varies both in colour and composition according as to whether this compound is alkalized or not. Thus, in a weak solution of potash, the product is of a very dark brown or black colour, and this is permanent under the circumstances. In weak acetic or hydrochloric acid, it evolves gas (probably oxygen), and acquires a pale red colour. A large volume of distilled water

added thereto produces the same kind of change. This may be an oxychloride. If, on the other hand, an alkali is omitted, the silver salt acquires a pale-reddish colour, and undergoes that chemical change which is generally imputed to it when subjected to light,—that is, it passes to argentous-chloride with evolution of chlorine; while hydrochloric acid is also produced in a secondary way (no doubt from the chlorine), and this, being free, is antagonistic to the formation of that dark product which results, as I have said, when photographic effect is produced in the presence of alkaline matter.

7. Iodide of silver forms, as I have before shown,* a bright yellow compound with mercuric-iodide, as administered thereto in the form of mercuro-iodide of potassium. This compound, I have just ascertained, contains only about one-quarter per cent. of mercuric-iodide.

8. The quantity of mercuric-chloride which has to be present in argentic-chloride so as to render it insensitive to light, need not be more than 1·16 per cent. of the whole compound.

9. Most of the aniline dyes are absorbed to a small extent by these silver salts.

10. Argentic-chloride is to a very slight extent hygroscopic. In the dark at 22° C. a well washed sample of this compound gained ·11 per cent. of water.

11. Oxidizing agents generally, when applied to argentic-iodide which has been faded by light, turn its colour to a full yellow.

12. Argentic-iodide precipitated from an excess of argentic-nitrate has its dull yellow colour changed to bright yellow by ammonia; but this yellow relapses to the normal hue upon the addition of water thereto in quantity. But if the argentic-iodide prepared in this manner is first thoroughly modified by light, ammonia then browns in the place of yellowing it, and the addition of water causes a relapse to its former colour.

I will for the present only make the following few remarks upon these notes.

In 1 and 2 is shown in a marked manner the necessity of water in some form for the production of photographic effect upon argentic-iodide, and also of a temperature very far below its fusing point, facts which should, when fully realized by chemists, lead to a knowledge of the exact molecular change which such an effect involves.

The opposing effect of sodic-chloride to the action of light on silver salts (3), when taken in connection with results 8, 9, and 10, seems due to the formation of a double salt therewith which is not sensitive to this agent.

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* Trans. N. Z. Institute, Vol. IX., p. 555.

The effect of a gentle heat in obliterating photographic impressions (4) is no doubt called into play, where, as Claudet observes, "exposure to the red rays neutralizes the effect previously produced on a sensitive surface by white light."

From results Nos. 7, 8, 9, and 10, it is seen that these silver salts have a predisposition to combine with small or even minute quantities of certain substances, the same as molybdic acid and its congeners have in relation to phosphoric acid, and this, without doubt, indicates a molecular change throughout, and one which, at least in the case of argentic-iodide, is possibly of the same nature in respect to structural form as that which light induces. It has been ascertained by Vogel that in the case of this salt (argentic-iodide) no silver or iodine is liberated by light—the change is molecular only; so that the experimental results detailed above may have a significance in regard to the mode in which light produces this. But being a change apparently of this character only, it is not a little singular that water, or its constituents, is necessary for its production; and it was this that led me to make experiment (5), under the idea that water is assimilated by this salt when photographic effect takes place upon it. The result, however, as is seen, does not show this to be the case; but further experiments seem necessary here.

From the results last described (11, 12) it is seen that most oxidizing substances have the property of putting argentic-iodide, altered by light, back to its normal state, and that this salt comports itself with ammonia according as to whether light has been permitted to exert its influence thereupon or not, results which have no doubt an intimate relation to the phenomena under consideration, but in what way it is difficult as yet to discover. The primary effect of ammonia, however, in the last result is, it would seem, merely to form feebly ammoniacal compounds with the silver salts, which are so unstable as to be decomposable by water.

ART. LXII.—*Further Notes upon the Movements of Camphor on Water.* By WILLIAM SKEY, Analyst to the Geological Survey Department.

[Read before the Wellington Philosophical Society, 21st February, 1880.]

SINCE my paper "On the Movements of Camphor on Water"* was read before you, I have learned that this subject has been especially treated by Professor Tomlinson, in one of a series of "experimental essays," dated 1863. This work I cannot get hold of; but the theory which this scientist there

* Trans. N.Z. Inst., Vol. XI., p. 473.

maintains to be explanatory of these movements, is re-stated in a controversial letter which appears in the "London Chemical News."* This theory is quite antagonistic to the one I advocated in the paper of mine referred to, as it supposes these movements are due to a "difference between the tension of water and that of the camphor solution at different points of the surface."

I have also learned since the communication of this paper, that Mr. P. Casamajor has read one before the American Chemical Society, in 1874,† in which he ascribes these movements to electrical reactions, and in a letter of his published in the "Chemical News,"‡ he attempted to sustain this theory as against that of Professor Tomlinson. Along with this, I find that the subject of camphor-movement has been one of great interest to the scientific world since the year 1787, when Volta investigated it, followed by Carradori, Dutrochet, Dr. Thos. Young, and, in 1862, by Prof. Van der Mensbrugghe. A knowledge of this and of the more recent opinion of the two scientists first named, has induced me to make further investigation respecting the phenomena of camphoric movements, and the direction of which has, I am happy to acknowledge, been given by information supplied by Mr. Casamajor.

Before I give the results of this further investigation of mine, I will just say now what I have to say in respect to the rival theories which I have described to you.

In regard, first, to that of Mr. Casamajor, I have to inform you that I tried to reproduce some of the results upon which this is founded, and was quite unsuccessful. One experiment, especially, I tried several times—that where vulcanite electrically excited is applied to camphor which has been rendered stationary upon water by a glass-rod, and I entirely failed to set the camphor going. When one considers the effect which a minute portion of greasy matter has in arresting this kind of motion, one cannot avoid thinking that the unrecognized interference of such matters in Mr. Casamajor's experiments has vitiated the value of their results and so led him a little astray.

As regards Professor Tomlinson's "tension" theory, I cannot go over the evidence upon which it rests, as I am unable as yet to possess myself of it ; nor again can I examine the mode in which he makes the difference of tension described to result in camphor movement, as I have only a knowledge of the bare assertion itself, being, as I have said, unable to obtain the essay referred to.

Pending, therefore, the receipt by me of full and definite information of this kind, I must for the present forbear from any direct examination of the

* Vol. XXXVI., p. 937.

† "London Chemical News," Vol. XXXVI., p. 191.

‡ Vol. XXXVI., p. 285.

Professor's theory, and I now proceed to furnish you with an account of the results which I have obtained by the prosecution of the experiments which, as stated, I have been induced to make.

Now Mr. Casamajor states the fact, among others, that citric, benzoic, and carbolic acids resemble camphor in their ability to move upon water, and so pursuing this I have ascertained the following facts :—

1. That citrate of potash, acetate of potash, succinate of ammonia, and albumen dried at about 100° F., also describe movements upon such a surface.*

2. That the purer the water is *as regards matter dissolved therein*, the freer as a general rule these substances, as also camphor, move thereon. Thus camphor or citric acid, both very free movers upon pure water, either refuse to move, or move but slowly and in a confined manner, upon water saturated with carbonate or borate of soda, or with chloride of sodium.

3. That none of these substances are able to describe movements upon a solution of albumen in water if it contains more albumen than one in a thousand parts of solution ; nor yet upon weak gum-water ;† indeed, so unfavourable is gum-water to movements of this kind, that a mixture of one of gum to four of water refuses to allow olive oil to spread thereon, and allows even gasoline to move but slowly.

4. That white of egg or gum-water applied as a drop to water on which camphor is moving, peremptorily stops it ;—spreading as it does on the surface like oil, it behaves like it in respect to the movements described.

A consideration of these facts, especially as they relate to camphor—a substance which I take to be typical of the rest—shows in the first place, that water when combined with saline matter to a large extent is (although still in a liquid state) not favourable to the movement of camphor thereon. It is seen therefore that, for such movement to be of the liveliest, water in a free state or comparatively free state is requisite, consequently that the first essential for movement is a combination of camphor with water—a condition which you will remember I insisted on as necessary for such purpose. In the second place, it is seen that, while *solution* plays a necessary part in these phenomena, *mobility* of the sustaining liquid plays another. It is seen that water containing a little gum or albuminous matter refuses to allow camphor, etc., to move thereon ; and this is clearly due to the greater viscosity of the mixture over that of water. But though viscosity, as a property of the sustaining liquid, is thus unfavourable to movement, it appears to be neces-

* Acetate of potash or of lead gives no movement thereon. Cochineal, a substance composed of various principles, moves also.

† Healthy urine, owing to the gummy matter dissolved therein, has to be diluted to four or five volumes with water before it allows camphor to describe movements thereon.

sary as a property of the substance floating thereon; for it seems to be certain that all the substances here cited which describe movements upon water, with the exception of camphor, form solutions or compounds with water possessing more viscidity than water does. As regards camphor, we can get no positive evidence that the substance it forms upon water is thus more viscid than water, as we cannot collect it in sufficient quantities for the examination necessary; but we may safely assume, from analogy, that it is viscid, and highly so. I think it may be taken as a fact that any solid, which, when placed upon water, has a greater tendency to spread upon its surface than to combine with the bulk of it (as camphor, citric acid, etc., do), will form a compound therewith of a nature more viscous than water. I suppose the solution thus radiating from a solid along the water surface to be saturated, as in such a condition its viscosity will be greatest. I need not demonstrate to you that a substance which forms with water a compound more viscid than water, should spread largely when placed in contact with the surface of water; it is a mere physical matter, one of least resistance; such substances encounter but little more than half the resistance to movement when extending along the surface than when penetrating the liquid underneath; the movement in the former case is, too, far more rapid than that in the latter; but as capillary attraction is probably concerned as an accelerator of such movement, I cannot well claim that this superior rapidity is a measure of the greater ease with which the viscid product extends itself over the surface than it does internally.

And now with special regard to the *cause* of camphor movement: it will occur to you that if the compound which camphor forms with water is so highly viscid as I here maintain, the movements in question may have their stimuli in part due to an effect springing out of this viscidity; it would seem that,—as there is a constant production of this viscid substance close to the camphor, and a little above the water-line, as well as on it,—this substance exercises a slight pressure on the camphor in virtue of its viscidity, and the camphor, therefore, is urged wherever the solution is less viscid. I conceive this supposition to be a correct one, and, therefore, that in addition to the motive power capable of being derived from the effect of superficial affinities and adhesions, as cited in my former paper upon this subject, there is that derivable from an unequal solution of the substance operated with in a menstruum of unequal viscosity.

Art. LXIII.—*On the Mode in which Oil acts as a Nucleus in Super-saturated Saline Solutions; with Notes on the Mode of Action of Solid Nuclei.* By William Skey, Analyst to the Geological Survey Department.

[*Read before the Wellington Philosophical Society*, 21*st February*, 1880.]

In a paper read before the Royal Society of England "On a relation between the Surface Tension of Liquids and the Super-saturation of Saline Solutions," by Charles Tomlinson and G. Van der Mensbrugghe,* it is stated that certain oils, both volatile and fixed, when applied to any of these solutions, "act as powerful nuclei;" that is, they cause the solidification of these solutions, by determining a crystallization of a portion of the salt thereof, which, when started even on the most minute scale, progresses sometimes slowly, sometimes at a speed giving an appearance of instantaneous effect, until the whole of the solution has solidified; a phenomenon which, I may remark, is of a somewhat striking character when witnessed and considered upon.

This phenomenon is held by these investigators to be explained upon the theory, which they propound, "that whatever tends greatly to lower the surface-tension of a super-saturated saline solution, causes a separation of salt, and at once puts an end to the condition of super-saturation." The theory is backed by formulæ, by frequent determination of tensions, and by experimental results of a very solid and varied character. But there are other results of theirs which do not appear in accordance with it, and the endeavours made to show them to be otherwise have the effect only of rendering this apparent unconformity the more conspicuous to me, and, besides that, of creating towards the theory itself a feeling unfavourable for its reception.

It was under such an impression as to the insufficiency of the tension theory to account for all the facts given in their paper that, for a better understanding of the matter, I referred back to an investigation of mine, communicated to you last year; and by this I feel strongly persuaded that a factor in the problem—why oils sometimes act as nuclei?—has been left out of it—and a factor of such high value, as to reduce the part which tension plays therein (if, indeed, played at all) to one of a very subordinate character. This factor which I would bring to your notice is that of chemical affinity,—the affinity of one or more constituents of the oil used as the nucleus for the water of whatever solution is operated with.

In the communication referred to "On the Nature and Cause of Tomlinson's Cohesion Figures,"† you may remember I stated the constitution of these figures to be fundamentally different from that which is assigned

* See also London Chemical News, Vol. 25, p. 281.

† Trans. N.Z. Inst., Vol. XI., p. 490.

them,—*e.g.*, their annular markings being hills of oil, and the ground in which they are set a resin; and that, further, I stated these figures to be caused by the resin dissolved in these oils leaving them for the water, the surface of which they monopolize to the comparative exclusion of the oil, owing to their affinities for it being greater than those of oil for the same liquid. Now, granted all this, and I have not yet heard of anyone disputing it, the explanation of the problem set us—the nuclear action of oils in super-saturated solutions—becomes an easy matter.

Such solutions, as they are most likely to be made, are super-saturated to the highest degree possible at a given temperature, in short are saturated super-saturated solutions; and so, for the initiation of the change in view, require divesting of but the minutest portion of water, and this will hardly fail to be immediately effected by the application thereto of any old vegetable or animal oil, as such contain resinous matter much of which is so far metamorphosed as to be of a decidedly acidic nature. The affinities for water of these resinoid matters may be feeble, but they certainly have to contend with affinities also feeble; nor, it should be remarked, is the resulting product entirely or even notably soluble in water, or such resin might behave only as salts, which when added thereto are ineffective as nuclei; but water is taken away from the solution to be incorporated with such matters in a solid form, and so a portion of salt is liberated to form the nucleus for a general solidification. But it should follow as a consequence that, if resin is the cause of nuclear action, a freshly made oil may not have nuclear action of the kind at all; and this is exactly what we are told by these investigators, they find that while "turpentine old but bright and clear acted powerfully as a nucleus" it afforded when distilled a liquid which was not then active. Another example they give is that of an old oil of bitter almonds which they experimented with. This oil though strongly nuclear gave a distillate which was non-nuclear; and again we learn from them that the oils of commerce as we have them, even those of the same kind and presumably of the same quality apparently, any way having surface tension very similar in degree, vary in the same way that the oils named above do.

Now all the cases occurring in which oils are non-nuclear are explained I believe by my theory upon either the very probable supposition or the fact that they do not contain resinous matter; but these cases are certainly not explained by Professor Tomlinson and his associate. They show that in the case of active and inactive oil of turpentine their tensions were to each other as near as 2·2 to 2·4, a difference admittedly insufficient to account for their mutual diversity in relation to the saline solution upon this tension theory. With all deference therefore to the opinion of these eminent

scientists, I will now affirm that such facts are irreconcilable with this theory of theirs.

The question I have started as to whether or no surface tension has an effect, even of a mere subsidiary character, in producing these nuclear effects described, I leave for solution to those physicists who for so many years have been working at the mechanical properties of liquid surfaces.

But I must remark, ere I leave this part of my subject, in relation to the effect or non-effect of any specific oil in producing crystallization, that in regard to this, not only does the more or less resinous condition of an oil affect it, but also the more or less proneness it has to become resinoid upon exposure to air and water; and this brings us face to face with another fact elicited by these investigators. It is, that in dull, damp, and cloudy weather an oil may not produce nuclear effect; whereas on a fine bright day it may be "particularly active." This they explain by supposing the surface tension of the solution to be lower upon cloudy than upon bright days. But in connection with my theory (the chemical one) I would point to the well-known fact, that light in conjunction with air favours the change of oil generally to resinous matter, and hence an acquirement of nuclear effect on bright days.

Another and the last remark I have to make here is, that in all those experiments with oil where a nuclear effect is produced by these scientists, a flashing or spreading out of such oil from the lens-shape it may first assume, is the constant concomitant or antecedent. Now, this uniformity of action is misleading, for it impresses one with the idea that any oil which spreads over the surface is one which will have, when fairly tried, a nuclear action; and so it has the effect of prepossessing one unduly in favour of the tension theory. As a matter of fact, however, I find that gasoline, an oil of very feeble tension, too, spreads rapidly over such solution without producing any solidifying action, so it is not nuclear, thus breaking the uniformity hitherto observed.

On the other hand, however, we may take it for granted that in every case where a nuclear action is exercised by an oil, there is more or less of a surface spread of the oil accompanying such action.

And now in pursuance of the next part of my paper: it is relative to the mode of action of solid nuclei in super-saturated solutions, and is merely a description of certain results I have obtained thereon, while the subject of liquid nuclei was under consideration. Two of these results are, I believe, novel to scientists (Nos. 4 and 5). The others are got by repetitions of experiments by investigations which have often led to results diverging more or less from one another. They are recorded, not under the idea of settling a question about which there is great debate, but only as a small and possibly

a useful contribution to those who have taken this question as an especial subject for research.

These results are : —

1st. That crystals of the common hydrated sulphate of copper, epsom salts, nitrate of baryta, borax, and glauber salts, after being sluiced with water, and while still wet all over, do not act as nuclei in a super-saturated solution of sodic acetate when applied thereto.

2nd. That on the other hand a crystal of sodic acetate similarly treated (as above) does act as a nucleus with such solutions.

3rd. That chloride of sodium does not when sluiced and mixed while wet with a super-saturated solution of alum, act as a nucleus thereto, but that a crystal of alum similarly treated does.

4th. That the formation of solid sulphate of baryta formed in any of the super-saturated solutions of a sulphate (by adding baric-chloride thereto) is not attended or followed upon by the crystallization of such solution.

5th. That the electro-deposition of copper in a super-saturated solution of either sodic acetate or alum (charged feebly with cupric sulphate) is also unattended by crystallization in either case.

These results show that only those salts* which are of the same kind as that of the super-saturated solution, are nuclear thereto, and they also tend to show that solids having no affinity for water have not any nuclear effect in such solutions, not even when applied thereto as freshly prepared, perhaps I may correctly say in a nascent state.

It will be seen, therefore, that so far as these results are indicative of anything at all, their general character is such as to sustain De Gernez† in his assumption that "sudden crystallization of a super-saturated solution is in all cases induced only by contact with a crystal of the same salt" (allowing, of course, that he excludes from his cases those of the oils and alcohols, also salts, having notable affinities for water) ; and so far they are antagonistic to the results of Jeannel, as stated in the same work, viz., that any solid substance applied to such a solution of sodic-acetate causes crystallization, and so tends to upset the theory by which he seeks to explain the phenomena in question.

A due consideration of all which has been now advanced on this subject will, I think, have the effect of inclining you strongly to the following general deductions which I draw therefrom :—

1. That the only substance which acts *directly* upon a super-saturated solution as a nucleus, is a salt of the same kind as that of such solution,

* Only those salts are indicated here which have feeble affinities for water; it is always understood, I believe, that those having strong affinities for it are left out of the question.

† Watts' Dictionary of Chemistry, Vol. V., p. 350.

hydrated to an equal extent with the salt which is separated thereby. It is just probable, too, that such a salt must be in a crystallized form.

2. That in all those cases where substances other than the salt of which such solution is made are nuclear thereto, they act for this in an *indirect* manner, the first step being a removal of water from such solution, and this causes a portion of salt to separate—to form in its turn a nucleus capable of acting directly on the solution. Nuclear action is therefore, in these cases, always a result of secondary action.

ART. LXIV.—*On the Cause of the Deposition of Camphor towards Light.*

By WILLIAM SKEY, Analyst to the Geological Survey Department.

[*Read before the Wellington Philosophical Society, 21st February,* 1880.]

IT has often been observed that when camphor has long been kept in a glass bottle which is not evenly exposed to light, it detaches in part from the bulk to encrust with crystals that side of the bottle which is " most exposed to light." This partiality of camphor for the more illuminated surface is ascribed, as I take it, to an effect of light as an etherial undulation distinct from that of heat possibly electrical.

However, a few experiments which I made in this matter, show very clearly that sublimation and condensation (as produced by heat and cold respectively) are the sole cause of this kind of deposition. The whole matter turns upon the diathermacy of the glass of the bottle used : though exposed to light most, it warms but slowly and up to but a little way in the thermometric scale. The camphor, however, absorbs the heat thus transmitted by the glass, and the vapours formed thereby condense thereon, but for them to select that side "most exposed to light" it is necessary that there be *upon* or *near to* the other (the further side) some body absorbent of heat, so that by its conduction therefrom, *viâ* the air, to this side, its temperature may be raised to a higher degree than that of the other side, a circumstance of course always obtaining in those cases where camphor is deposited towards light. If no such kind of back-ground is present the camphor deposits most upon that side of the bottle which is the furthest away from light.

In all probability the indications of weather got, or supposed to be got, by the use of " camphor storm-glasses," are also produced not by electrical or actinic action, or by light and heat in conjunction, as Dr. Parrion suggests, but by variation of temperature only.

Art. LXV.—*On the Nature of the Precipitate formed by certain Mercuric Salts in presence of Essential Oils.* By William Skey, Analyst to the Geological Survey Department of New Zealand.

[*Read before the Wellington Philosophical Society*, 21*st February*, 1880.]

In a paper read before you last year* I showed that mercuric-chloride, when added to a mixed solution of mercuro-iodide of potassium and any essential oil, determined a white precipitate therein in the place of that red coloured one which would form were the oil omitted; but while I showed how these precipitates could be distinguished from those produced by such mercurial salts in the presence of the alkaloids and the albumenoids, I did not inform you as to the precise nature of these precipitates, being then ignorant of it myself. Since then, however, I have, in order to settle this point, acquired a wider knowledge of the whole matter, and so am enabled to inform you that other substances, not exactly essential oils but partaking somewhat of their nature, also behave like such oils in respect to the mercurial compounds named; and by this wider knowledge of the subject I am also enabled now to describe the nature of these precipitates to you.

These substances are camphor, carbolic acid, kerosene, gasoline, picrotoxia, and guaiacum resin.

In regard to kerosene and gasoline it is only a very small portion of these substances which is ever concerned in the production of any colourless mercurial precipitate; and so I consider this part to be a portion of the oil which has been oxydized by the air to an acid hydrocarbon, or to something on the way to this.

And now, as to the nature of the precipitates:—

Camphor.—As I have got that obtained in presence of camphor,—none of the camphor is present. I merely decanted the liquid portion off, and allowed the residue to dry in the air at a low temperature. The pale yellow mass thus resulting turned to a bright scarlet colour when pressed, as the iodide of mercury does, but kept its yellow colour for months; I may say, indeed, it would do this permanently, if left alone. As this yellow mass does not contain camphor, it is certainly the pure mercurial iodide; and the reason, therefore, that it does not (as it is termed) spontaneously redden, is that its particles are so detached among themselves that, except for some outside agency, they cannot get sufficiently within each other's influence to favour the molecular action necessary to produce this change of colour.

Guaiacum Resin.—This resin, in acetic acid diluted with water, furnishes a solution which, like the other oils and resins named here, does not afford a precipitate with mercuro-iodide of potassium, but when afterwards treated

* Trans. N.Z. Inst., Vol. XI., p. 470.

with mercuro-chloride, a pale one forms, of some permanency as to colour. This compound, however, differs from the others which I have described in being of a soft plastic nature. It passes through filter-paper as readily as the analogous compound with digitaline. It reddens under pressure—a singular circumstance, considering that a resinous matter is certainly present throughout it, and as it seems, combined therewith. That a purely mechanical force, as pressure, can not only modify the chemical (or, at least, molecular arrangement) of a substance like mercuro-iodide,—but actually eliminate a substance (and one which is, besides, non-volatile at the temperature used) from its combination with this salt (mercuro-iodide), in order to pass such mercuro-salt to its more fixed or final form,—would be a phenomenon of so unexpected a nature, that one hesitates to accept this view of the case, and feels inclined, for the present, to consider the colorific change in question to be favoured by a decomposition of the precipitate prior to its being dried for the pressing. Urea behaves with these mercurial salts much the same as this resin.

Carbolic Acid.—The compound formed by these mercurial salts in presence of this acid, appears in the form of opalescent oily globules, which neither subside nor are retained by paper-filters; however, by the addition thereto of a little common salt, these agglomerate and finally precipitate in the form of a light yellow solid, which when dried preserves its colour even when strongly pressed by a hard substance; it also sublimes without undergoing any notable chemical change, and the sublimate is also unaffected by pressure. From these results it appears that the pale precipitate in question contains carbolic acid, and is a compound possessed of considerable stability.

Picrotoxia.—Picrotoxia, by the process described, forms a compound with mercuro-iodide having considerable stability; its colour is not affected by pressure; it is not chemically affected except at a comparatively high temperature, in which case it chars and evolves gaseous matters.

I need not detail any further results, as the cases I have selected for this are typical of all I have investigated. I will only refer back to the precipitates formed in presence of the more volatile substances cited, for the purpose of stating my belief that as the less volatile oils certainly combine with the mercuro-iodide, the more volatile ones in the first instance are also in combination with it, but a combination so unstable that it is difficult to isolate them for examination.

I should state that these mercuro-compounds are, as a rule, soluble in alcohol, ether, mercuro-iodide of potassium, or mercuric-chloride.

These results show that in examining for albumenoids or alkaloids by the mercuro-iodide and chloride test, it is necessary to remove all resinous

or oily matter which may be present in the solution to which such test is applied. This can generally be accomplished by shaking such solution with a little pure hard fat, at its fusing-point, and removing the crust which forms on cooling.

In conclusion, I would desire to point out to you that by some of the facts above stated may be explained that difference which has arisen between Reynoso and Schiff respecting the character of the precipitate produced by adding water to alcohol in which has long been dissolved mercuro-iodide; the former has stated it to be red; the latter, to be yellow—a discrepancy which is readily susceptible of explanation upon the very likely assumption that in the case where such precipitate is yellow, an oil was present in the alcohol used.

Art. LXVI.—*On the Decomposition of Argentic-oxide by Mercury.* By William Skey, Analyst to the Geological Survey Department.

[*Read before the Wellington Philosophical Society, 21st February,* 1880.]

Upon the authority of Fisher it is now supposed that argentic-oxide is not decomposed by mercury; but I find that, when these two substances are kept for some weeks in contact, whether in light or not, a considerable quantity of silver amalgamates with the mercury, and a crust of yellow mercuro-oxide is formed, demonstrating that this silver compound is divested of its oxygen by mercury, but at a very slow rate of speed. The same decomposition takes place if the two substances are kept immersed in caustic potash.

V.—GEOLOGY.

Art. LXVII.—*On Wind-formed Lakes.* By J. C. Crawford, F.G.S.

[*Read before the Wellington Philosophical Society, 13th September*, 1879.]

The scientific world has had its say upon rock-basins and the action of glaciers in scooping out beds of lakes; and some, indeed, venture to work out the solid materials in that manner in such lake-basins as that of Wakatipu, with its surface 1000 feet above the sea, and its bottom 300 feet below the sea-level. I have, however, nowhere read of wind-formed lake-basins; and I, therefore, propose to describe shortly how they may be and are formed.

If we suppose a flat, composed of sandy soil say, more or less covered with vegetation, and on it a slight depression, which may be caused by the action of the wind blowing the loose soil away—in this depression storm-water will lodge. This lodgment destroys the grass and other land-plants which may have been growing on the surface; and when the pool has dried by evaporation, the surface of the depression is in a fit state to be again acted upon by the wind, any aquatic plants which may have sprung up being destroyed by the drying-up of the water. A further deepening and possible enlargement of the pool takes place, and this process goes on until rain again falls and forms a temporary lake. At length the lake may attain sufficient depth to retain its water throughout the year, and then vegetation may spring up round its borders, and a stability of years or of centuries may be attained.

There have been, I think, a considerable number of wind-formed lakes in New Zealand, many of which have been destroyed by the effects of colonization and the introduction of stock. The fires of the settlers, and the grazing and tread of cattle, destroy the vegetation on the shores of the lake, the sand is set blowing, and the lake is either destroyed or altered in position.

I am inclined to think that part of the Wairarapa Lake has been formed by the wind. There is a line of sand-hills on the eastern shore which there is little doubt is composed of sand blown from the lake-bottom when that had dried up. I by no means suppose the whole lake to be wind-formed, because, as a rule, I do not suppose it to have, or have had, a sandy bottom;

but it is easy to suppose the eastern part to have filled up with a deposit of sand, to have become dry ground and supported vegetation, which afterwards gave way to the effects of wind or fires during a dry season, when the water again took possession, the sand being driven to leeward to form sand-hills. The Wairarapa or the Canterbury Plains offer peculiar advantages for the formation of wind-formed lakes when the condition of a sandy soil is present. The north-west wind descending obliquely from mountains, with accelerated force through certain gullies, has a swooping action, which of course cannot affect the gravels and clays, but if it meets with sand can soon make a hollow for the reception of water. If this hollow should be in a position to be filled by storm-water, springs, or neighbouring streams, it becomes a lake, or possibly a swamp.

The nature of the surrounding soil must also be such that the access of water to the hollow shall not be able to cut a channel of egress for it, otherwise the lake will be drained from natural causes.

I place Burnham Water as a typical example of a wind-formed lake, and there is also a small lake below my house, which I have called the Miramar Lagoon, which had every appearance of being a permanent lake when the settlers arrived in the district. Since that time, from the destruction of the flax and other vegetation which surrounded it, it has undergone many changes, and is now generally dry in summer time.

There is another mode of wind-formation of small lakes which I have observed, viz., by sand blowing across the mouth of a gully and damming back the water. This sort of lake gradually fills up with sediment, and eventually becomes a swamp, and, later on, dry ground. There are several examples of this sort of lake on the peninsula of Hataitai, in the different processes of lake, swamp, and dry ground.

Art. LXVIII.—*On Bidwill's Front Hills.* By J. C. Crawford, F.G.S.

[*Read before the Wellington Philosophical Society, 10th January*, 1880.]

There is a low range of hills, about seven or eight miles in length by about one mile in breadth, down which the road runs from the Featherston and Waihenga Ferry road to Mr. Bidwill's house, which forms an interesting meter of the immense work which the action of rain and rivers has performed in the Wairarapa Valley.

This range separates the low part of the valley to the westward towards Featherston, from the equally low part on the east containing the river flats of the Ruamahunga and the Wharekaka Plains. The height of these low

plains is not much above the sea-level, let us say 20 or 30 feet, while the height of the ridge in question, I should estimate, in its highest part, to be fully 300 feet above the sea. Now this is higher than the level of Greytown or Carterton, and the corresponding level will probably be found in the middle of the Taratahi Plain.

At first sight there is nothing extraordinary in finding a spur running out from the mountains into a plain, but when we examine the structure of this ridge we find much upon which to speculate. I am aware that there are some remains of old rocks, apparently belonging to the Rimutaka series, in the core of the ridge in question, because years ago I found them myself, but the mass of the range appears to be entirely composed of river-borne gravels and clays (perhaps the latter would be better described as muds). The cuttings for the formation of roads bring this point more clearly to view than formerly.

Now this ridge having been formed of river-borne gravels and clays, the water at the time of its formation must have stood or run at a higher level than it, the ridge, stands at present, and either great denudation of the lower valley must since have taken place on both sides of the ridge, or the slope of the ridge must show a tendency to a termination of the deposit, either as a talus of materials dropped into a lake or as a finish-off of the deposit, when the rivers stood at a level of several hundred feet higher than they do now.

Bidwill's range is clearly a continuation of the deposits of gravels and clays which are found on the front ranges of the Huangaroa station, and through which the Ruamahunga has burst, leaving the former range isolated.

It is conceivable that the Ruamahunga and its tributaries ran originally along the ranges on the western side of the Wairarapa, until, by the increase and spread of their deposits, they gradually forced the bed of the main river to the eastern side of the valley and against the eastern ranges. If at this time we suppose the river to have had a channel over three hundred feet above its present level, we can account for the formation of Bidwill's range. Afterwards the river would cut its channel through its own deposits and carry its material further down the valley.

I am more disposed to believe in the existence of a former barrier and a great extension of the present lake, than to suppose the immense denudation of previous deposits of gravel and clay which is probably involved in any other supposition. The general evenness of the Wairarapa Plain seems to point to a spreading of the surface materials under lake water, and I think the appearance of the lower valley, approaching the lake, and including Bidwill's range, gives a similar impression. We might call in

earthquake-action to account for the elevations and depressions, but I do not see any evidence to warrant it.

The amount of work which has been done by the Wairarapa rivers seems utterly out of proportion to their present strength, and either an enormous period of time must be allowed, or the amount of water must have formerly been vastly greater. The old deposits are precisely similar in character to those which are brought down at the present day. The Ruamahunga and its tributaries of the right bank, or from the Rimutaka, run clear and chiefly bring down gravel. The Taueru, coming from tertiary rocks, brings down softer materials, *viz.*,—sand, clay, and mud; and, after its junction with the Ruamahunga, a difference in the deposits from those in the upper valley may be observed, both in old and new deposits. We may, therefore, conclude that the same rivers which are at work now, have done the work formerly. Possibly by shutting up the Manawatu Gorge, that river might find its way, by some low saddle, into the basin of the Ruamahunga; or some change of level near the sources may have induced it to cut a channel to the West Coast.

Even supposing we bring the Manawatu into the Wairarapa Valley, we have apparently a small supply of force for the quantity of work done. To cover a valley, say sixty miles long and ten broad, with gravels and clays several hundred feet thick is an immense operation, which has been perhaps only exceeded in recent times in New Zealand by the rivers of the Canterbury Plain; but these rivers are much larger, and run from much higher mountains. There are other parts of the Wairarapa which may probably answer as texts as well as Bidwill's front hills, but I have neither time nor opportunity to take the levels, make the necessary observations, and draw the conclusions, and must therefore leave it to others to work up this interesting subject.

Art. LXIX.—*Remarks on Volcanoes and Geysers of New Zealand.*

By W. Collie.

[*Read before the Wellington Philosophical Society, 14th June*, 1879.]

In the pleasant, if sometimes arduous, pursuit of art-photography, the writer camped for weeks close to the main volcanoes and geysers of the colony, enjoying excellent opportunities for search into the origin and working of these marvellous and attractive exhibitions of nature's powers. And viewing the existence, or it might be termed life, of the earth in its present state for at least thousands of years, the question naturally arose

to the wayfarer of to-day amongst these interesting scenes:—"Whence the activity which still pours forth the boiling waters of Rotomahana to run glistening down the silica terraces of their own constant formation—wherein the force that lights the red fires which burn ever in the crater of White Island—or what the motive power that still throws up a cone in the crater of Tongariro (Ngauruhoe)?" The reply from the waters of Rotomahana, from the fires of White Island, and from the cone of Tongariro was the same—the one word, "*Sulphur.*" Whether the almost universally imagined heat of the interior of the earth has any existence in fact does not materially affect the subject; for it was enough to the observer that sulphur in its natural state lay beneath the crust of the earth in beds of greater or less extent, being self-combustible when heated and moist, smouldering for long years—burning near the surface sufficient to melt the rocks and throw them out as lava and pumice amidst fire and smoke, and with reports like cannon—or heating the internal waters which came into contact with it, and forcing them up as minerally impregnated geysers, or as sulphurous steam. It was easy to follow out the idea and conceive how these inflammably begot forces, confined in the interior and unable to escape, have raised the land into mountain-masses; or, as the material consumed, have caused the crust of the earth, sometimes gradually, at other times violently, to sink into the empty caverns. Hence earthquakes but wait upon the sulphur fires below, and attest their wide-spread power. Whether at boiling cauldron or bursting crater the only inflammable or explosive substance to be seen is *Sulphur*, and the only effect observable is that from its fire. Steaming basins, smoking craters, and destroying earthquakes, it may be safely assumed, never occur without the presence of *Sulphur* as the good or evil genius of the phenomena.

Rotomahana.—During the writer's stay at the Terraces he was favoured with an exhibition of the subsidence of the waters of Te Tarata into the caverns below; and as the Terraces on that occasion got dry, it was noteworthy how brittle the silicious surface became, showing upon what a slender thread the beauties of that mountain side hang; for, were the flow of the blue waters to stop, as stop it must when the energies of the forces below exhaust themselves, the glory as well as the cause of Rotomahana will disappear.

Tongariro (Ngauruhoe).—When the writer visited the crater of Tongariro in May of last year, there was a cone on the north-west side of it. This cone was about 120 feet wide at the top, and was closed at the bottom as if the volcano had not been in action for a considerable time. Upon the writer's climbing the mountain (a feat always attended with difficulty and risk) and descending into the crater, in December following, he found that

the above cone had completely vanished, and that along the greater part of the north side of the crater another cone, about 500 feet wide at the top, had been violently thrown up. In the interior of this cone, at the bottom, there were two openings opposite each other, out of which sulphurous steam was blown in considerable quantities. The outside of the cone was of loose material, as might be expected from its recent deposition, and was composed of stones, pumice, cinders, and debris of the mountain.

It is thus evident that this volcano is still active, although at uncertain periods. Over the floor of the crater, and up aloft, along the sides, as well as outside the mountain, sulphur-steam was issuing in all directions, tinging the orifices with yellow crystals of sulphur. The whole crater of Tongariro might be 1500 feet wide. The loose burnt sides, overhanging the floor, are gradually falling down, altering the configuration of the summit of the mountain. Upon the floor of the crater there were several thick patches of hardened snow; and at the north side, under the cliffs, a large wreath of snow, melting from the heat beneath, formed a singular-looking cavern with a scalloped roof, as of white marble. The writer spent a night inside the crater, and found the air intensely cold till the sun rose high enough in the morning to shine into the crater. Astronomers, in scanning the volcanoes of the moon, have noticed about the middle of the floor of certain craters a small cone, giving rise to speculation about its cause. Does not Tongariro afford explanation—that, as the volcanic forces exhaust themselves, they give vent to their expiring fires by a small cone.

White Island.—It is generally supposed that the vapours arising from White Island are steam from geysers; whereas, sulphurous steam never rises to any height. The main forces of the grand display at the "Theatre of Nature" upon White Island, are burning beds of sulphur, which show their red fires at night across the lake, whilst the fumes rise up into the air in volumes, to spread there at a great height, like a balloon, or to flow away in a train over the sea before the breeze.

PROCEEDINGS.

WELLINGTON PHILOSOPHICAL SOCIETY.

FIRST MEETING, 14*th June*, 1879.

A. K. Newman, M.B., President, in the chair.

New Members.—A. S. Birch, G. Allen, R. Lee, Hugh Pollen, — Edwards, J. Hayward, C. E. Zohrab, C. Callis, R. S. Waterhouse, T. C. Richmond, R. T. Holmes, E. Lee (of Napier), D. Mills, Dr. Collins.

1. "Account of two Journeys to the Summit of Mount Ruapehu," by G. Beetham, M.H.R.

ABSTRACT.

The author graphically described the beauty and grandeur of the scenery observed on the journey, and the difficulties and dangers encountered in endeavouring to reach the highest point. An excellent model of the mountain was exhibited, by means of which the author was enabled to point out clearly the exact route taken, and the various points of interest met with during the ascent. Specimens of the different rocks collected were also on the table. On the second ascent the author was accompanied by Mr. J. P. Maxwell.

Mr. Maxwell gave some additional information regarding the nature of the country passed through, and also explained fully the model of the mountain before the meeting.

2. "On Volcanoes and Geysers in New Zealand," by William Collie. (*Transactions*, p. 418.)

Dr. Hector, after reading this paper, said that Mr. Beetham's paper contained many interesting facts, and to that gentleman the credit was due of being the first to organize a party to ascend this mountain. He himself had travelled all round the base of the mountain, but had no opportunity of making the ascent, so that he could not speak with any certainty of the formation, but he considered it one of the earliest volcanoes in the North Island. He gave an account of his own ascent of Tongariro on the 23rd November, 1867, and explained that the active steam eruptions on the side of the mountain were due to the percolation of water from a cold lake on the summit, a sketch of which he exhibited.

Mr. Travers would like to know something about the vegetation met with on such a journey, as Dr. Hector gave a list of plants differing from alpine plants in the South Island.

Dr. Hector then exhibited on the screen with a lantern, views of both Ruapehu and Tongariro.

3. Some very interesting exhibits of iron ores, recently discovered by the Geological Survey Department, were on the table, two of which Dr. Hector considered deserved special mention in connection with efforts that the Government is making to encourage the manufacture of iron in the Colony. Both the ores were discovered by Mr. A. McKay, of the Geological Department, during the progress of the survey in the past year. One is a brown hæmatite containing 54 p. c. of metallic iron, which occurs in a bed 50 feet thick, but is reported to expand in places to several hundred feet. It is associated with crystalline limestone at the base of the carboniferous formation, and extends for many miles through the western ranges towards the source of the Takaka River. The specimens obtained were from the surface, and deeper down it most probably passes into red hæmatite, a much richer ore that contains 70 p. c. of metal. This is, no doubt, the continuation of the same band of iron ore that reaches the sea at Parapara. The other form of ore was discovered at Jenkins' coal mine, close to the town of Nelson, and is spathic ore, or carbonate of iron containing 40 p. c. of metal, in a form of combination that is very favourable for smelting, being in consequence one of the most valuable description of iron ores known. It was not found *in situ*, as the workings are abandoned, but it has been thrown out with the *debris* from the coal pit in considerable quantity, its valuable qualities having hitherto escaped notice.

4. Specimens of 17 new species of grasses, described in a paper by Mr. Buchanan, were laid on the table.

Second Meeting. 26*th July*, 1879.

Martin Chapman, Vice-president, in the chair.

New Members.—H. W. Saxton, of New Plymouth; W. H. Holmes.

1. "On the Forest Question in New Zealand," by A. Lecoy, LL.B., M.A. (*Transactions*, p. 3).

The Hon. Mr. Waterhouse thought the author too sanguine as to the success of such an undertaking in New Zealand at present, at the same time believing it to be highly important that conservation of New Zealand forests should be commenced, as no doubt in the future some such scheme as the author advanced might be carried out. He could hardly agree with the author's estimate, especially as regards the value of our timber as compared with others, or as to the small expense of management when the present price of labour is considered.

Dr. Newman agreed with Mr. Waterhouse. He did not think we could compete with other countries, especially on a large scale. The author was mistaken as to the great value of our timber; still, it was most important that New Zealand forests should be protected.

Mr. Blundell, while considering the paper valuable, thought the calculations and estimates scarcely reliable. He agreed that conservation should be carried out with the view of future operations.

Mr. O'Neill was of opinion that great weight should be attached to the views of the author, as coming from one who had devoted so much of his time to the question of forestry, and who could speak on the subject with so much experience. He, himself, agreed that some of our timbers were superior in many ways to those used elsewhere. The author deserved the thanks of the society for having brought forward such an important subject.

The Rev. Mr. Ottway agreed with the author, and considered that probably the estimate as regards our timber was even under-stated, but that the real value of the timbers could not be ascertained until a market had been created for them. He mentioned his own experience in districts in the North Island, where puriri trees, which could at one time be had for the asking, in some eight years become worth 25s each, and that since that time (1874) that timber had been in great demand for railway trucks and gun-carriages, and had become a considerable source of wealth to those who had conserved the trees. He also pointed out that the peculiar value of the New Zealand timber lay in the large size of the hardwood logs that could be obtained.

Dr. Hector thought it of the highest importance that this subject should be thoroughly inquired into, and the author deserved great praise for the trouble he had taken in preparing the paper. Anyone who helped to bring about the conservation of our forests conferred a public benefit.

Mr. Kirk had listened with pleasure to the paper. He thought the extent to which conservation should be carried out ought to be considered; also the question as to its effect on climate. There was nothing in New Zealand to compare with the oak or spruce. Kauri was our best timber, but unfortunately it was fast disappearing.

Mr. Lecoy replied at some length, and refuted many doubts cast by previous speakers on the value of his statistics. He thought that when his paper had been read carefully, it would be found that his views were supported by experience.

On the motion of Mr. O'Neill, the further discussion of this paper was adjourned until next meeting, to afford members an opportunity of perusing it as it deserved.

2. "What should be the highest aim of the Wellington Philosophical Society," by Dominick Brown.

ABSTRACT.

The author pointed out that there were many subjects other than questions purely scientific which might be encouraged among the members, and which would benefit not only themselves, but the community at large.

Owing to the lateness of the hour the discussion on this subject had to be postponed.

Third Meeting. *9th August*, 1879.

A. K. Newman, M.B., President, in the chair.

New Member.—J. S. Prendeville.

1. "Suggestions towards a Theory accounting for the Movements of the Magnetic Needle," by the Hon. R. Hart, M.L.C.

An interesting discussion followed, in which Messrs. Martin Chapman, J. T. Thomson, Robert Pharazyn, and the President took part, some of the speakers differing from the views set forth by the author.

2. "On the Forest Question in New Zealand," by A. Lecoy.

Discussion on this paper was then resumed. The following members spoke on the subject:—Messrs. Campbell, Marten, Chapman, J. T. Thomson, H. Blundell, R. Pharazyn, T. Kirk, and Dr. Newman; and by all the author was complimented on the able manner in which he had dealt with this most important subject. The speakers, while not being

quite so sanguine as the author regarding the success at the present time of the establishment and working of a State Forests Department in New Zealand, generally admitted that ultimately such conservation of our forests, if carried out by Government under proper supervision, would prove successful and profitable, but scarcely to the extent indicated by Mr. Lecoy. In the course of the discussion, Mr. J. T. Thomson gave some valuable information, supported by statistics, bearing on the subject of forest conservation in New Zealand, and referred to experiments made in this direction in Southland which had not succeeded. Mr. Kirk pointed out, with others, the importance of planting our large waste tracts of land, as well as conserving, and drew attention to the immense quantity of waste timber in the colony, particularly in the north, and suggested that it should be utilized as in America, namely, by our locomotives.

Mr. Lecoy replied at considerable length, drawing attention to many points in his paper that were most important as bearing on the value of our timbers, and repeated his firm conviction that, if properly and systematically carried out, a large and profitable timber trade could be established between New Zealand and other countries, which would yield a considerable State revenue.

In the course of this discussion, Mr. W. D. Campbell moved, and Mr. Blundell seconded :—"That the Council of this Society be requested to consider the advisability of representing to the Government the necessity for forest conservation, and of obtaining the co-operation of the affiliated societies of the New Zealand Institute for furthering the object."

Fourth Meeting. 23*rd August*, 1879.

Martin Chapman, Vice-president, in the chair.

New Members.—Oliver Wakefield, T. F. Rotherham.

1. "On the Medical Aspects of Education," by W. G. Kemp, L.R.C.P. Lond., M.R.C.S.Eng. (*Appendix.*)

The Hon. Mr. Waterhouse said this was a most important subject, and the author deserved great credit for bringing it forward. He thought some importance should be attached to conversational education. The particular taste of the child should be studied, and the mind and body developed at the same time.

Mr. Young agreed with Dr. Kemp. The teachers, however, were not to blame; they had to carry out a system without any choice. It was always high pressure, and the children were pushed beyond their strength.

Mr. Woodward thought this subject was more addressed to parents, who had the greatest influence over their children. He objected to the great amount of home work given to school children. The work in school hours was quite sufficient as a rule.

The Rev. Mr. Ottway said that the standard of knowledge required in our New Zealand schools seemed to go on increasing, and the consequence was that all was done in a hurry and the brain upset. The teachers in country districts were expected to do with the children as much as those in towns, while the country children had not the same opportunities.

Mr. Blundell spoke in favour of the paper, and said that he thought intoxication was in a measure due to overwork of the brain of young people, after leaving school.

2. "Pronouns and other Barat Fossil Words compared with Primeval and Non-Aryan Languages of Hindostan and Borders," by J. Turnbull Thomson, F.R.G.S., etc. (*Transactions*. p. 223.)

This was the last of a series of five papers devoted to an inquiry on the "Whence of the Maori." The author explained the various steps he had taken in his investigations—(1) ethnological, (2) philological, and latterly, glossarial. He by this means originally traced the connections between the various tribes of Polynesia, Malaya, and Madagascar, and latterly the affinities between them and the primitive races of Hindostan. During his enquiries his attention had wide scope, he having had to scrutinize about 150 vocabularies of Asia, 200 of Africa, 25 of Australia, and 50 of America, in none of which, outside of the area occupied by the Malagas-Malayo-Polynesian races, had he detected root or fossil words, excepting in Hindostan and borders, and exceptionally on the east coast of Africa, near to Madagascar. All the evidence adduced, including that of fossil words, pointed to archaic Hindostan as the original seat of the Malagas-Malayo-Polynesian race. That country was therefore the "whence of the Maori," a fact particularly interesting to New Zealand settlers. To get rid of a long name for one race, he had taken the liberty to call them Barata, ancient Hindostan having been termed the land of Barat by the Malays, as expressed by their poetry—to wit: Angin Barat galombang sulissei, ahioh nona, etc.; as by the Hindoos, Bharata, and as by the Malagasi, Avaratra, all one word, according to the phonology of each language. This interference with the dogmas of old New Zealand writers and historians was no doubt very obnoxious, yet he would hold to the designation till he saw some facts brought forward to overturn his theory. The author next alluded to subsequent glossarial though pre-historic influences in the languages of the Malay Archipelago, particularly of the Aryan or Sanscritic, which, though imposing many words, these, in no case were radicals. Later again, and within historic times, Arabic, Persian, and even Portuguese, had affected the languages, but only in a similar manner. None of these languages had imposed a single word on Polynesia, the Arabic alone having had slight influence on Malagasi as regarded tertiary terms. The whole inquiry indicated a very remote or archaic connection between the insular tropical tribes extending from Madagascar to Easter Island and the Land of Barat, *i.e.*,—ancient Hindostan.

In the discussion that succeeded, Dr. Buller made remarks on the Moriori of the Chatham Islands; Mr. Knorpp, on the Todas of the Nilgherries in India; the Hon. Mr. Waterhouse, on Sanscrit in Polynesia; Mr. Chapman, on the physical geography of the area occupied, on the Tamil Bell,* on the navigation between Sumatra and Madagascar, and on the ideal continent once occupying the site of the Pacific Ocean;—to all of which the author shortly replied.

3. "Moriori Connection," by J. Turnbull Thomson, F.R.G.S., etc. (*Transactions*, p. 237.)

Fifth Meeting. 13*th September*, 1879.

Martin Chapman, Vice-president, in the chair.

1. "On the Medical Aspects of Education" (Part II.), by W. G. Kemp, L.R.C.P.Lond., M.R.C.S.Eng. (*Appendix.*)

Mr. Woodward thanked the author for having drawn attention to this subject in such a carefully thought out paper. He stated that the questions of lighting and seats would in future receive more consideration.

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* *Vide* Trans. N.Z. Inst., Vol. IV., p. 40, and plate.

Mr. J. T. Thomson and the Hon. Mr. Randall Johnson complimented Dr. Kemp on his paper, which contained many suggestions which it was most desirable should be adopted.

2. "On Wind-formed Lakes," by J. C. Crawford, F.G.S. (*Transactions*, p. 415.)

Mr. G. M. Williams said he had noticed small lakes on the West Coast formed, no doubt, in this way.

Mr. Maxwell had seen small pools of this kind, but hardly to be called lakes. He scarcely thought the Wairarapa Lake had been formed in this way.

3. "On Grasses and Fodder Plants," by S. M. Curl, M.D. (*Transactions*, p. 382.)

The Hon. Mr. Randall Johnson pointed out the value of such a paper as this. He did not think farmers, generally speaking, could carry out such experiments; it should more properly be done by Schools of Agriculture, which he hoped soon to see established in the colony. They had made a commencement in this direction at Christchurch. He might instance one plant, the prickly comfrey, that had been highly recommended as likely to do well in this country, but which had been rejected. It did not suit the climate or soil—two things of the greatest importance.

Mr. Kirk stated that the most important point mentioned by the author, the necessity of a mixture of several grasses in order to form good pasture, had been stated in early volumes of the Transactions of the New Zealand Institute. He had felt somewhat disappointed in not finding any new matter brought forward in that portion of the paper which had been read. The general statements, with regard to the utter want of attention paid to grass culture, required qualification, as considerable improvement has taken place in New Zealand during the last few years. He had seen excellent grass paddocks in the district in which the author resided, and knew that a large quantity of seed of the best natural and artificial grasses was imported into the Rangitikei district annually.

He fully agreed with the author as to the desirability of encouraging the growth of some of the native grasses, several of which were of proved value when mixed with those ordinarily cultivated, as might be seen in several localities near Wellington, and in other parts of the colony.

One or two incidental matters mentioned by Dr. Curl involved issues of considerable interest, but he would only notice one of these. The author stated that plants were capable of being acclimatized, or according to the popular meaning of the term, of becoming so modified by cultivation as to be enabled to endure a climate very different from that for which they were originally adapted by nature. Now there was not the slightest evidence in support of this statement. It would be correct to say that in many cases the proper mode of cultivation had not been discovered until after many failures, but that was a very different matter from such a gradual alteration in the constitution of a plant as would enable it to withstand the effects of a climate for which it was not naturally suited.

Sixth Meeting. 27*th September*, 1879.

A. K. Newman, M.B., President, in the chair.

New Member.—J. Park.

1. "Remarks on Forest Planting and Conservation, with reference to particular Localities in the Wellington District," by G. W. Williams.

ABSTRACT.

The author pointed out the evil results arising from the indiscriminate destruction of the forests, especially at the head-waters of our rivers, and its climatic effect. He mentioned many localities where planting could be carried out successfully and with profit. He also drew attention to the large sand-dunes which might be advantageously fixed by planting.

Mr. Govett did not think the land at Taupo, mentioned by the author, worth growing trees on—the expense would be too great.

The Rev. Mr. Ottway would like to know whether the gum-tree really did impoverish the ground to the extent supposed. He was inclined rather to think that, owing to their rapid growth, they exhausted the soil, thereby retarding the growth of other trees, but that they did not injure the soil.

Mr. Travers gave an interesting account of forestry generally, and referred to the successful manner in which the sand-dunes in France had been protected by planting, and how, among other things, the vines succeeded well in this sand; and he saw no reason why this plant should not do well here under similar circumstances, and a large industry be created. He pointed out how land suffered from the wholesale destruction of our bush, which should be put a stop to. Large tracts of land in France were laid waste from this cause, the floods which followed doing considerable damage. It is due to the clearing of the bush that the Hutt River is so often flooded.

Mr. Kirk thought the paper was of great value. It was both suggestive and practical. The evil results referred to might be seen in several localities near Wellington, where the hills, having been denuded of trees, now carry a scanty crop of grass, with frequent bare places. Had a patch of bush been left on the upper portion of the hill, the grass on the lower portion would have been much more luxuriant and suffer less during dry weather, as the rain would have been stored in the humus amongst the trees, and gradually given off for the benefit of the lower portion, instead of rushing away in a flood. With regard to the suggestion of planting portions of the Taupo Plain, he considered that it would be preferable to sow them with some of the Australian *Acacias*, more valued for their bark, such as *A. decurrens* and *A. pycuansha*. Large quantities of mimosa bark are imported annually, and there is a constant market at remunerative prices. In Victoria, *Acacia* plantations are said to yield a yearly profit of £5 per acre. He agreed with the author as to the desirability of fixing our coastal-sands, but should object to his proposition to sow furze. The subject had been copiously treated in the sixth volume of the Transactions of the New Zealand Institute. Perhaps the best plan for ordinary situations would be to sow seeds of deep-rooting *Lupins*, *Pinus austriaca*, *P. insignis*, etc., with barley and creeping-rooted grasses, but it would be necessary to cover the sown surface with light bush, in order to keep the seeds from being blown away. The barley would germinate quickly, and at once fix the surface to a certain extent, so that by the time it died away the ordinary grasses would have become well rooted.

Mr. Maxwell said that there were many localities where the flow of sand was so great that no planting could possibly be carried out;—it is only in particular localities where it would succeed. Only certain kinds of the pumice at Taupo would carry vegetation.

2. "On the Doctrine of Mind-Stuff," by F. W. Frankland. (*Transactions*, p. 205.)

On the motion of Dr. Kemp, seconded by Mr. Maxwell, the discussion on this paper was postponed until a future meeting, to give members an opportunity of reading it carefully.

3. "Notes on the Nesting Habits of the Orange-wattled Crow," by W. D. Campbell. (*Transactions*, p. 249.)

The egg of this bird was exhibited.

Seventh Meeting. 11*th October*, 1879.

A. K. Newman, M.B., President, in the chair.

New Members.—R. Ward, Major Nixon, T. F. Fuller, A. T. Bate, E. J. Von Dadelzen.

1. "On the Occurrence of Giant Cuttlefish on the New Zealand Coast," by T. W. Kirk, Assistant in the Colonial Museum. (*Transactions*, p. 310.)

A life-size drawing of the animal was exhibited and parts of the skeleton.

Mr. Travers said that in Sir George Grey's work on Polynesia mention was made of these large cuttlefish, and it was evident that the Maoris were aware that they frequented these seas.

Mr. Chapman stated that even a larger one than any mentioned in the paper was recorded as having been captured in Newfoundland. The author omitted to mention the peculiarity in the eye of the cuttlefish, which was identical with that of a mammal.

Dr. Newman thought the so-called fins, at the extremity of the animal, would be found to be only expansions of the skin.

2. "Remarks on some curious Specimens of New Zealand Birds," by T. W. Kirk. (*Transactions*, p. 248.)

Specimens were exhibited.

3. "On certain Results obtained upon some of the Argentiferous Salts which are affected by Light," by William Skey, Analyst to the Geological Survey Department." (*Transactions*, p. 401.)

4. "On the Principle of New Zealand Weather Forecast," by Commander R. A. Edwin, R.N. (*Transactions*, p. 40.)

The President said that this paper was of great value, and would no doubt be eagerly read when it appeared in the Transactions.

5. Dr. Newman read extracts from a paper on "Notes on Port Nicholson and the Natives in 1839," by Major Charles Heaphy, V.C., communicated by the President. (*Transactions*, p. 32.)

Eighth Meeting. 1*st November*, 1879.

A. K. Newman, M.B., President, in the chair.

New Member.—W. H. Cutten.

1. "A Reply to Mr. Frankland's paper on 'The Doctrine of Mind-stuff,'" by C. W. Richmond, a Judge of the Supreme Court of New Zealand. (*Transactions*, p. 215).

Dr. Newman, having been educated in a materialistic school of thought, was as much shocked as could be the most orthodox of believers. He thought Mr. Frankland exalted mind far too much instead of relegating it to its really insignificant position in the universe, and suggested that he could just as easily prove that matter was electricity-stuff as Mr. Frankland had proved that it was mind-stuff.

Mr. Chapman followed, and very largely agreed with Mr. Frankland's doctrines.

Mr. Frankland then replied.

Dr. W. L. Buller, C.M.G., F.R.S., was chosen to vote in the election of the Board of Governors for the ensuing year, in accordance with clause 7 of "The New Zealand Institute Act."

NINTH MEETING. *22nd November*, 1879.

Martin Chapman, Vice-president, in the chair.

New Members.—Dr. Gillon, George Drury.

1. "On the Cultivation of Beet for the Manufacture of Sugar, etc.," by S. M. Curl, M.D.

ABSTRACT.

The author went fully into the subject, and gave the result of extensive experiments made by himself, with the analysis of the roots, showing per centage of sugar. These experiments were carefully compared with the returns from other countries, and proved, in his opinion, that an industry of this kind would be most successful, and return large profits to all who took part in it.

Mr. Chapman said that when lately in Germany he had made a point of collecting information on the subject of beet cultivation. The profits there were enormous at that time, so much so that the Government had levied a tax of 45 per cent. on the gross production of sugar. There had, he believed, been a slight decline in this industry, which, however, had risen again.

Mr. Kirk did not agree with many of the author's statements on the subject, but as there was a rather small attendance, and the subject was a most interesting one, he would move that the discussion be adjourned until next meeting, which was carried.

2. "On *Melicerta ringens* and *Plumatella repens*," by A. Hamilton. (*Transactions*, p. 301).

Drawings of the animals were exhibited.

3. "On the Ignorance of the Ancient New Zealander of the Use of Projectile Weapons," by Coleman Phillips. (*Transactions*, p. 50).

Mr. J. T. Thomson gave some information bearing on the question in a philological sense.

TENTH MEETING. *10th January*, 1880.

A. K. Newman, M.B., President, in the chair.

New Members.—Rev. W. M'William, J. W. Henley.

1. Dr. Hector gave an account of the Sydney Exhibition, and exhibited a series of photographic views of it on the screen.

The following papers were taken as read :—

2. "Description of a new Species of Lizard of the Genus *Naultinus*," by W. L. Buller, C.M.G., Sc.D., F.R.S. (*Transactions*, p. 314.)

3. "On Bidwill's Front Hills," by J. C. Crawford, F.G.S. (*Transactions* p. 416.)

4. "Notes on Fishes in Upper Whanganui River," by Captain Mair, F.L.S. (*Transactions*, p. 315.)

5. "Additions to the List of New Zealand Fishes," by T. W. Kirk, Assistant in the Colonial Museum. (*Transactions*, p. 308.)

6. "Notes on New Zealand Plants," by J. Buchanan, F.L.S. (*Transactions*, p. 380.)

7. "A few Remarks on Art Perspective," by R. T. Holmes.

Annual General Meeting. 21*st February*, 1880.

A. K. Newman, M.B., President, in the chair.

Minutes of last Annual General Meeting read and confirmed.

New Member.—J. L. Moffitt.

ABSTRACT REPORT OF COUNCIL.

There have been ten general meetings of the Society held during the past year, the attendance at which has been rather above the average, and at which forty-two papers were read.

Twenty-nine additional Members have been added to the roll, making a total of 281 names.

The Council arranged for a series of popular lectures, but only two were delivered—one by Dr. Newman, on "The Brain in relation to Mind," and one by Mr. S. H. Cox, on "Combustion." They were well attended; and the Council are of opinion that another trial should be made in this direction.

A list of works added to the library, either as donations or by purchase, is attached, and it will be seen from the statement of accounts that a large portion of the funds of the Society has been expended during the year in the purchase of new and useful works of reference.

The statement of accounts showed that the total receipts of the year were £323 15s. 9d. and that there is a balance in hand of £4 2s. 7d., while £36 14s. 2d. (being one-sixth of the nett income) had been handed to the New Zealand Institute in compliance with the statute, and a further sum of £27 had also been paid to the Institute as a contribution towards the expenses of printing Volume XI. of the Transactions.

Election of Officers for 1880:—*President*—Martin Chapman; *Vice-presidents*—Dr. Hector, C.M.G., F.R.S., Dr. Buller, C.M.G., F.R.S.; *Council*—F. W. Frankland, S. H. Cox, F.G.S., F.C.S., Hon. G. Randall

Johnson, M.L.C., W. T. L. Travers, F.L.S., T. Kirk, F.L.S., A. K. Newman, M.B., M.R.C.P., J. P. Maxwell, A.I.C.E ; *Secretary and Treasurer*—R. B. Gore ; *Auditor*—Arthur Baker.

A vote of thanks was passed to the retiring office-bearers.

Dr. Newman, the retiring President, then delivered the following

ANNIVERSARY ADDRESS.

When looking over the "Transactions of the New Zealand Institute" searching for ideas for an address, I was struck by the fact that though geology, botany, zoology, meteorology, and chemistry had each been carefully and diligently studied by many persons, and though the volumes contained many valuable and able monographs on these and kindred subjects, yet that one subject had rarely been discussed, indeed, I may say, had been almost entirely neglected ; that subject is—medicine. With one or two trifling exceptions, there has been almost nothing done in the way of monographs on medical subjects in New Zealand. A few surgeons have described cases of poisoning from the bite of the katipo, and one or two have written scraps on the medicinal uses of three or four indigenous plants.

After ruminating over the subject for a time, it occurred to me that I would take as the topic of my address "New Zealand, from a Physician's point of view."

This colony has been studied from most points of view, *e.g.*,—geologist, botanist, zoologist, politician, agriculturalist, and so forth, and it seemed to me that it would not perhaps be wasting the time of this Society if I were, for this once, to regard New Zealand in its medical aspect ; because, after all, though usually ignored, the subject of disease is one of more or less importance to all of us.

I have often thought that a physician might write a very interesting work on the difference in the diseases suffered by civilized and savage races of man, and the physician in New Zealand has the opportunity of so doing, in addition to which he can notice the effect resulting from the diseases of one attacking members of the other race.

People are apt to consider disease as some weird mysterious terrible thing, something like the ogres and hobgoblins and giants of our childhood ; and before science had gone probing everywhere, this was not only the popular, it was the universal conception of the nature of diseases. Now, however, we are wiser, and we define disease as anything wrong in a part or the whole of the body. We obtain the clearest idea of disease when we regard the human body as an exceedingly complex machine. We all know that in any machinery, the more elaborate it is, the more likely it is to get out of order ; and the more intricate and numerous the kinds of work to be performed by any machine, so much the more likely is it to get out of order.

Savages like the ancient Maoris, led simple monotonous lives, and the duties which they had to perform were few and simple. With civilized people on the contrary the lives led by all are much more varied, the struggle for existence is keener and more varied, and hence they are liable to, and suffer from, a great number of diseases which never have existed among the savages. You can easily see that an untutored savage, who never held a pen in his hand, could not suffer from writer's cramp, or scrivener's palsy. Clearly a race of savages who painted their houses with red or yellow ochre because their land contained no lead, could never suffer from painter's colic or lead palsy.

Savages who lit their fires by the slow but harmless method of rubbing two sticks together, could not have disease of their jaw-bones from the manufacture of matches. No Maori maiden ever committed slow suicide by tight lacing ; or damaged her health by eating slate and drinking vinegar ; and no Maori dandy was ever poisoned by gaudy socks. No Maori child ever killed itself by sucking green toys (arsenic).

No Maori milkman ever distributed typhoid fever with his milk. In fact, even did space permit, we could fill many a page recounting the diseases from which Maoris could never have suffered. Here is a striking fact. No old Maori ever had delirium tremens; no old *rangatira* ever had the "horrors"—not even "hot coppers;" no old Maori ever called his friend a "drunken sot," or "brainless idiot." Unfortunately, as they were all teetotallers, there was no special class of men who could clearly prove that if it were not for the use of strong drinks, there would be no lunatics and no criminals, and scarcely any disease. As a matter of fact there were plenty of all these evils.

Not one of all the descendants of the canoes that came from Hawaiki ever suffered from gout. In England one family held an estate for 400 years, and as each man succeeded to the inheritance, so surely did he also inherit severe gout.

Imagine an old Maori chief suffering from *rich gout*, when he had for food irregular and often scanty allowances of fern-root, dried eels, and an occasional slice of man or woman; his favourite tipple being a mild infusion of tutu-berries, or perchance a little pure water, weakly flavoured with the juice of flax-flowers. Of course no genuine old Maori ever had gout.

No young Maori lad or lass ever broke down reading for honours, or became crooked in the spine from sitting for hours on a backless bench; nor of any Maori child could a local poet sing—"with blinded eyesight poring over miserable books." The Maoris, like all the races of men, suffered from insanity. Idiots were not uncommon. Insanity was usually of a melancholic nature. Two things combine to make insanity little visible among savages: in the first place the amount of brain power required in the struggle for existence is far less among the savage than among the civilized races, and therefore deficiency in intellect is not so marked; and, secondly, savages use their brains but little, their lives are monotonous, they never suffer from commercial panics, and their brains are never over-worked.

If one went carefully through the 1,600 and odd diseases mentioned in the Royal College of Physicians' work on Nomenclature of Disease, one could pick out a great number arising from the complexities of life in civilized countries, and from which the Maoris never suffered; it might from this be inferred that the Maoris were a particularly healthy race. Such, however, was not the case. They had few distinct diseases, but those were so common that the aggregate illness was great.

Undoubtedly in the wake of civilization there do follow and arise many diseases, but judging from the longevity of the civilized men and their rapid rate of increase there can be no doubt that civilized people are, on the whole, healthier, suffer less pain, and live longer than do savages.

Then, too, look how carefully we nurse our invalids, and how much the Maoris neglected their sick friends. Why, I have seen a well-to-do old chief apparently crying bitterly over his dying wife, and yet, rather than go to the expense of burning her bed, which he must have done had she died on it, as it would have been *tapu*, he put the stricken woman on the bare hard floor to die. In sickness they had no comforts, and only injurious treatment.

Many Darwinians hold that physicians really help to deteriorate the race by prolonging the existence of the sickly, who would otherwise be weeded out in the struggle for existence, and that these sicklier persons propagate a sickly race; but a comparison will show that we civilized whites, with physicians, are a stronger, longer-lived, healthier, more capable race than the Maoris, with only their harmless medicine men. The fact is, though it would take a long essay to demonstrate it, that modern healing art benefits not only the individual but also the race.

From a medical point of view the Maoris are a singularly uninteresting race. As far as is yet known, they could not boast of one single new disease, unless it were a form of leprosy called *ngerengere*, and even that can scarcely be called a special disease, for it, or some species near akin, is very common in Fiji and in Polynesia generally. This *ngerengere* was first accurately described by Dr. Thompson in an article which appeared many years ago in the "British and Foreign Medico-Chirurgical Review." It is a species of *Elephantiasis græcorum*. *Ngerengere*, or leprosy, was at one time frequent among the Maoris, probably being most frequent among the poorest tribes. As with leprosy everywhere else in the world, it has almost disappeared before the march of civilization. Half-putrid eels and maize, and miserable fern-root and herbs and filth, all favoured its spread; whereas good, well-cooked, nutritious diet, with cleaner habits, have largely caused it to disappear.

Maori lepers were strictly quarantined.

The disease is now very rare; and any existing case will rapidly improve for a time under improved food and care.

I have not heard that any European ever suffered from it.

As in all other things temporal and spiritual, we have given diseases to the Maoris and received nothing in return. To them we have given measles, scarlet fever, typhoid, small-pox, and many others, and probably, as time rolls on, we shall give them more.

Maoris suffered from very few diseases, but those few were very rife. They had strange theories about diseases, attributing them as a rule to the action of evil spirits (*atua*). They thought that for every disease there was a special *atua*. Thus, *Rongomai* and *Tuparitapua* were gods of phthisis and atrophy of the legs and arms. *Tonga* was the god of headaches, and *Hi-tangata* god of the stomach; whilst *Koro-kio-ewe* presided over women in childbirth, and inflicted many evils. *Hine-te-iwaiwa* was the goddess of midwifery, according to another account.

By some tribes lizards (*ngarara*) were supposed to cause all diseases, and in the afflicted part a lizard was supposed to exist; thus, a pain in the chest was due to lizard, and so with pains in the head and elsewhere. They believed that lizards actually existed in those organs and wilfully caused these evils. A little green lizard (*Lacerta viridis*) was held especially baneful.

A similar notion prevails among the people of many savage and semi-civilized nations.

The chief diseases from which the Maoris suffered were rheumatism in all its forms, consumption, and scrofula. Consumption was with them, as it is with us, the most frequent cause of death. This disease is especially disastrous to half-castes. In the Maoris phthisis ran its course exactly as it does with us, and varied in no way, except that the Maoris as a rule succumb very quickly, and seem to have very scant power of resisting its ravages. This, however, may be due to the fact that they have no idea of care or nursing. Consumption was very largely induced by the unhealthy lives led, by the hot steamy air of their *whares*, and by an utter disregard of the simplest conditions of hygiene. Hæmoptysis was regarded as a sure sign of impending death.

Scrofula was very common, as might have been expected, when we reflect how ill-cooked and innutritious was the diet of the Maoris, and how specially unsuitable it was for infants and young children. One of the consequences of this want of proper nourishment was seen in the frequency of cases of humpback, due to caries of the spine—often with cure by anchylosis at right angles. Colenso ingenuously accounts for the frequency of crooked spines by stating that it arises from the carelessness of the women, who carry-

ing their infants on their backs were apt to strike them against the lintels of the doors. Since the arrival of the Europeans, and in consequence of their civilizing tendencies, and better and more regularly acquired diet, this disease is tending to become less.

It would appear that the children were, as a rule, born healthy and well made; but few being deaf and dumb, or deformed. Hare-lip was known, and instances of children with six fingers and six toes on each limb were not uncommon. Albinos were not rare.

Colenso says that the flax was often carelessly applied to the umbilical cord and sometimes slipped, giving rise to umbilical hernia. This can scarcely be correct.

Owing to the badness of the food most Maori children were pot-bellied, shrunken-limbed, wizen-faced looking wretches who improved wonderfully under a generous diet.

Maori women flattened their infants' noses, and Colenso describes a curious plan for making handsome the lower limbs of their children: they rubbed the knees, and the inner side of those joints were squeezed to attain this object. He also says that they half disjointed the thumbs of female children to make them better able to hold and scrape flax. Maoris pierced their ears with sharp flints, and shaved themselves with sharp shells. Tattooing was often attended by great pain and inflammatory swelling; if the entire body were done at any one time it was apt to produce death.

Chinese of rank allow their finger-nails to grow very long, to show they are rich and need not do manual labour; a few rangatiras' daughters about Poverty Bay did the same thing, allowing their left thumb-nail to grow. I have seen the same thing in Rio Janeiro.

Remembering the physiological law that organs little used have little tendency to disease, one is not surprized at finding that the Maoris suffered very little from any forms of brain disease. Insanity usually assumed a melancholic type. Epilepsy was known. Apoplexy and hemyplegia were rare; nor is this to be wondered at when we remember that alcoholines never existed, gout was unknown, and rigid arteries were of doubtful existence.

Sunstroke was rare. In summer they got a fever from haunting swamps.

Goitre exists among the hill-abiding Ureweras, and, Dr. Hector tells me, among the white residents of Bealey.

Most of the diseases among the Maoris were due to their dirty habits—their whares, and filthy ragged mats were the chief sources of distribution; and to their bad, irregularly supplied food: hence the abundance of skin affections, and indigestion, and diseases arising therefrom.

Treatment.—The Maori treatment of disease was partly the result of their belief in the nature of disease, and partly based on practical experience.

Believing that disease arose through the agency of spirits—"*atua*," they naturally appealed to their priests (*tohungas*) to relieve them, either by propitiating or exorcising the evil spirits, and, just as amongst nearly all savages, the office of priest and physician was combined. *Tohungas*, by their incantations, were believed to cure diseases; and now and then, a *tohunga* would get a great name—his *mana* was great for a time, and he became the fashionable physician of the day, to whom flocked patients from far and near. These *tohungas*, like other "medicine men," only resorted to prayers, when they did not know what else to do. They used to treat rheumatism by blisters (caused by hot stones), by scarification, by embrocation with pigeons' oil, by poultices made of hot leaves, and by ordering a course of warm baths at Waiwera or Rotomahana, or elsewhere. I am not aware that they had any special line of treatment for phthisis. They found out by practical experience, like Prince Bladud of Bath, that certain springs were good for skin and other diseases, but they never made the further discovery that on Ruapehu they might found a second Engadine, as a sanatorium for consumptives.

Working on a wrong hypothesis, they arrived at a right method of treatment for certain diseases. This treatment was change of climate; but they changed their residence not because of the air, but, finding beneficial results, they believed these were due to the fact that when they moved they left their "*atua*" behind.

Of course the uncivilized Maori medicine men knew nothing of such means of restraint as straight-jackets or padded-rooms for maniacal or strongly-convulsed patients. However, they very ingeniously adopted another line of treatment. If a patient ate *karaka* berries, he was sure to be violently convulsed; so they dug a hole, lashed his arms to his side, tied his arms, put him up to his chin in the hole, filled up with earth—then let him have his fits.—(Colenso.) He sometimes got well.

Abscesses were opened long before they were ripe by means of thorns or shells, and were then violently squeezed, causing great pain. They also used hot poultices of leaves.

To stop bleeding, they used the old housewifes' common remedy—cobwebs.

In cases of suspended animation from drowning, they held a man upside down to let the water run out, and then hung him (heels still up) over a smoking fire. There are no trustworthy statistics showing the results of this plan.

If they wished to excite vomiting, they held the patient under water till his stomach was full, and then rolled him on the ground and squeezed him.

Certain tribes believed they could squeeze out diseases, and the *tohungas* used to lay their patients on the ground, and pile on weights. This plan sometimes produced ill results when carried very far, because the patient's life was squeezed out. Very learned London surgeons recently tried to cure cancer in the same foolish fashion.

From the habit of cannibalism arose one good, it taught them something roughly of human anatomy, and they could sometimes reduce a dislocation (Colenso), and use splinters for broken bones. Occasionally they amputated fingers and joints, but this was the limit of their achievements in surgery.

They used a few plants medicinally, *e.g.*, the shoots of the *koromiko*.

The *tohungas* practised much on the credulity of their patients, and are said to have used ventriloquism as an aid. They got certain offerings (fees), and, when they did not in the least know what was the matter, could look as solemn and as wise as a leading London physician.

They suffered indigestion, the result of ill-cooked semi-putrid eels, half-rotten maize, and other like food.

They much frequented the hot-springs; one near Tolaga Bay is much celebrated in skin diseases, and at times the natives make pilgrimages there, especially when afflicted with venereal affections.

The Maoris have acquired all our contagious diseases, and doubtless in time will acquire those which are the direct products of civilization. Scarlet fever, measles, small-pox, and typhoid fever, have all at times done much mischief. Syphilis and other venereal affections have been introduced. Syphilis does not seem to commit great ravages; but gonorrhœa and all its attendant evils are very rife, and are much aggravated by dirt and neglect. They seldom apply for treatment to European doctors. Perhaps the frequency of discharges in the women may account for part of the large amount of infertility, and be one among the many facts leading to extinguish the race.

From a medical point of view there is little to interest the physician who studies his fellow-colonists. With the rare exception of a person bitten by the *katipo*, who as a rule does not die though he suffers a good deal, and the occasional illness and still rarer death of some child, from eating poisonous berries, there is *not one single* disease which colonists acquire from the Maoris; not one single disease arising from change in the soil, or climate,

or diet, or anything whatever in the environment. Any emigrant from the mother-country, on landing here, is absolutely free from the danger of incurring any disease from which at home he would be exempt. In every other quarter of the globe our roving fellow-countrymen are liable to some new and special disease. Here the colonists suffer from no one single disease which they have not themselves imported. They have given many to the natives, but have taken not one in return.

We have imported a great many of the 1600 and odd diseases named by the Royal College of Physicians, and probably in time we shall import all the rest.

It is a singular thing that, spite of the numerous undrained marshes, we have no such thing as ague, or other malarious fevers; and as our population is well-nourished and well-to-do, scurvy, purpura, and kindred diseases are rare. Remittent, or famine fever, is unknown. True typhus has, I believe, never been seen in this country, though, unfortunately, typhoid, that disgrace of civilization, is everywhere. Diphtheria and influenza are very common. Cholera has not yet made its appearance on our shores, and from all such diseases as the plague, yellow fever, true dysentery, yaws, and beriberi, no New Zealand colonist has ever suffered. In many countries the manufacture of flax has been attended with severe septicemia fever, arising from the heaps of decaying organic material, but I am not aware that this has ever appeared here.

A strange fact is the absence of hydrophobia in dogs. In England, rats suffer from a parasitic disease; cats eat the rats and suffer, and children playing with the cats acquire it (*favus*): quite unknown here.

It is my impression that skin diseases are rare here, perhaps owing to the scantiness and the well-to-do character of the people.

Sunstrokes are rare.

Human beings who mix much with dogs, are apt to suffer from internal parasites, a disease called hydatoids. In Iceland, where the dogs live in-doors all the winter with their masters, it is exceedingly common, being one of the most fertile sources of death. In Australia it is also very common, but in New Zealand appears to be exceedingly rare.

As in Victoria, phthisis is very prevalent. The immigrants from Home suffering from phthisis improve here; but the young New Zealand born suffer severely, and when attacked have little power of resistance.

Of New Zealand remedies we know but little—in fact we may say nothing. Probably a careful search will discover a few valuable remedies amongst the flora; but by far the most powerful remedy will always be our mineral springs. And some day there may be fashionable resorts for consumptive persons high up amid the peaks of the Ruahine, or amid the glaciers of Mount Cook. Perhaps there will come a time when consumptives from Australia will resort to them in shoals, as they undoubtedly will to our mineral waters.

Dr. Hector then proposed a vote of thanks to Dr. Newman, not only for his able address, but for the manner in which he had performed the duties of President for the past year. Dr. Newman had always been most energetic, and had done all in his power to promote the interests of the Society.

Dr. Buller had great pleasure in seconding the vote, which was carried unanimously. This concluded the business of the annual meeting.

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1. "On *Neobalæna marginata*," by Dr. Hector.

A beautifully-prepared skeleton (recently obtained at Ohariu) was set up in the lecture hall for the inspection of members. This whale is chiefly interesting from its being a

pigmy representative in the South Seas of the great Mysticete or whalebone whale of the Arctic regions.

Dr. Hector also referred to having recently obtained a cow and newly-born calf of *Kogia breviceps*, the pigmy sperm whale of these seas. The anatomical details of these whales were reserved for a future communication.

2. "On a Deposit of Chalk recently discovered near Oxford in Canterbury," by Dr. Hector.

The author pointed out the value of the chalk for the manufacture of Portland cement.

The following papers were taken as read :—

3. "On Moa Feathers." by Dr. Hector.

4. "Description of a new Species of *Palinurus*," by T. W. Kirk, Assistant in the Colonial Museum. (*Transactions*, p. 313.)

5. "Descriptions of new Marine Shells," by T. W. Kirk. (*Transactions*, p. 306.)

6. "Notice of the Occurrence of *Vitrina milligani* in New Zealand," by T. W. Kirk. (*Transactions*, p. 307.)

7. "List of Marine *Mollusca* found in the neighbourhood of Wellington," by T. W. Kirk. (*Transactions*, p. 303.)

8. "Further Contributions to the Ornithology of New Zealand," by W. L. Buller, C.M.G. Sc.D., F.R.S.

9. "Contributions to the *Lichenographia* of New Zealand," by Charles Knight, F.L.S. (*Transactions*, p. 367.)

10. "Descriptions of new Flowering Plants," by T. Kirk, F.L.S. (*Transactions*, p. 393.)

11. "Notice of the Occurrence of *Lagenophora emphysopus*, and other unrecorded Plants in New Zealand," by T. Kirk. (*Transactions*, p. 397.)

12. "Description of a new Species of *Cladophora*," by T. Kirk. (*Transactions*, p. 397.)

13. "Further Notes upon the Movements of Camphor on Water," by William Skey, Analyst to the Geological Survey Department. (*Transactions*, p. 403.)

14. "On the Mode in which Oil acts as a Nucleus in Super-saturated Saline Solutions; with Notes on the Mode of Action of Solid Nuclei," by W. Skey. (*Transactions*, p. 407.)

15. "On the Cause of the Deposition of Camphor towards Light," by W. Skey. (*Transactions*, p. 411.)

16. "On the Nature of the Precipitate formed by certain Mercuric Salts in presence of Essential Oils," by W. Skey. (*Transactions*, p. 412.)

17. "On the Decomposition of Argentic-oxide by Mercury," by W. Skey. (*Transactions*, p. 414.)

At the close of the meeting, Dr. Hector called attention to a splendid collection of type fossils and minerals lately received from England for the Museum, part of which had been presented by Mr. J. Brogden and Mr. Alexander Brogden, M.P., and which were arranged on the tables for inspection.

AUCKLAND INSTITUTE.

FIRST MEETING. *2nd June*, 1879.

Rev. Dr. Purchas, President, in the chair.

New Members.—W. P. Hales, N. Harker, Neil Heath, T. Herbert, T. J. Harbutt, Rev. J. Paul, C. W. Sanders.

The Secretary read the list of donations to the Library and Museum, since the last meeting.

The President delivered the following opening address :—

ADDRESS.

We enter to-day on our twelfth session. Those of us who can look back to our first meeting for the reading of papers on the 4th of May, 1868, will note with pleasure the signs of progress by which we are surrounded. Our first list of subscribers recorded in our earliest minute-book, contains 23 names; now we number 288. We began without a home, and when, after many delays, we obtained possession of the site on which this building stands, we were lodged in a ricketty old conglomeration of wooden boxes, which did not contain an apartment fit to meet in, and in which we had difficulty in preserving such specimens as we possessed, while their suitable exhibition was altogether impossible. Now we possess the first instalment of the requisite buildings, erected in no niggardly spirit, with a fair portion of suitable furnishing, and a large number of valuable and interesting specimens, illustrative of several branches of science.

In literature, we have also made a good beginning. Our library contains a considerable number (about 1200) of scientific works of a high class. These have been obtained, partly by the expenditure of our own subscriptions and other funds entrusted to us, and partly by donations and bequests. Among the latest additions to our literary treasures, I may call attention to Gray's splendid "Book of Birds," in 3 vols., and to several volumes of "Conchologia Iconica," which has just been completed, after occupying many years in publication. We have at present but a part of this magnificent work, but hope, ere long, to obtain the remaining volumes. It is said that some persons have found fault with the Council for buying such costly books; but we maintain that this is just the place in which such works ought to be found. One of the objects for which we have united in the establishment and maintenance of our society is to provide works of reference which we could not attain in any other way. We have always cherished the hope that we might be able to obtain the means of providing a Free Public Library for the city on such a scale as should satisfy the requirements of readers in all branches of literature. But the hope still remains unfulfilled. We have indeed undertaken the custody of the collection of books formerly known as the Provincial Council Library, and have expended more than we could well afford in providing for the convenience of readers of those books, and so far the germ of a public library may be said to exist. It is, however, obvious that a large

addition to our buildings, and a great increase in our annual income, must be provided, before we can carry out our wishes to any considerable extent. The same remarks are applicable to all other parts of our work, either in actual progress, or in contemplation. We are cramped in every direction by the want of money.

In the department of geology, we have a large number of valuable rock specimens, including a typical collection specially obtained from England, which cannot be exhibited in the Museum for want of suitable table-cases. In Zoology there are many interesting and beautiful skins of birds and other animals packed away out of sight, because we have not the means to employ a taxidermist to set them up. We have no classes in any branch of science, not because there are no persons desirous to learn, but because we have not the means and appliances necessary to carry on the work of instruction. We have no laboratory, no apparatus, no suitable theatre for lectures, and no funds to provide these necessary things.

We hope that a beginning may be made ere long by the opening of a class for the study of botany, which has the advantage of being able to dispense with costly apparatus. In fact, such a class might be formed at any time under the care of our worthy secretary, Mr. T. F. Cheeseman, F.L.S., if a moderate number of pupils would agree to meet together, say once a week, for this useful and interesting study.

In the department of art a good beginning has already been made. The splendid casts of world-renowned antique statues which now, thanks to Mr. Thomas Russell, C.M.G., adorn our museum and excite the admiration of numerous visitors, are silent instructors of all who study them with open eyes; while special instruction is freely provided for those who, having the necessary natural gifts, desire to cultivate the limner's art. The classes established by the kindly thoughtfulness and liberality of our friend Dr. Campbell, under the charge of Mr. Kennett Watkin, are in full work, and making fair progress. The number of students of both sexes at present on the list is, I believe, 31.

I have thus endeavoured to point out the actual present condition of our Institute, and the desiderata yet to be supplied before we can fully achieve the purpose for which we have associated ourselves. The question, How are we to obtain the necessary means? is one which I am not able fully to answer. There are but two sources to which we can look, public grants and private munificence. Both of these have helped us in the past; to both must we look in the future; nor do I think that we shall be disappointed. Of private generosity we have already had noble instances, and we will not doubt that others as noble are yet to come. Nor will we believe that our statesmen will withhold due assistance from the public funds, when they consider the importance of the cultivation of science, literature, and art, to the welfare of the people whose funds they administer. It is true that elementary instruction must ever occupy the first place in the liberal statesman's thoughts. The key of knowledge should be put into the hands of all. But when we refer to schools of a higher class than the primary, it is impossible to ignore the claims of science to be included in the curriculum of instruction. Some eminent men contend that all children should be taught the elements of science. The German scientist Haeckel claims that the Darwinian theory of evolution should be made the basis on which State education should rest, but in this he is strongly opposed by his friend and former teacher Kirchow. The latter has, I think, clearly shown that Haeckel has taken up untenable ground. All will agree that truth is the one object of real scientific research, but there is need of caution lest we lose sight of the distinction between the certain knowledge of ascertained facts, which is rightly called science, and the exercise of the scientific imagination in hypothetical

deductions or theories. Theories are often, indeed, of the greatest service; but they are not to be made into dogmas. We may avail ourselves even of an erroneous theory (as, for instance, that of two opposite kinds of fluid in electricity) without suffering any great harm, if we hold ourselves ready to abandon it when found to be erroneous. A theory is not an object of faith, but a subject for discussion. In every part of the domain of science the facts which have been ascertained are of the first importance, and form the basis of all true teaching. But a knowledge of the general laws deduced from these facts, and established, as we may say, by consent of all who are capable of forming a correct judgment concerning them, must necessarily be communicated to the learner, and the more our knowledge of facts is increased and extended, the wider will our view become, and the better shall we be able to grasp the general law by which the phenomena may be comprehended. The student may be compared to a traveller exploring an island having a mountain in the centre, from the top of which a full general view can be obtained of the whole, and a correct idea can be formed of its shape and features. The higher he climbs the more he can see; and though with much labour he may gain the summit, his view will still be limited by the horizon, and even within the narrow bounds of his domain there will be a multitude of objects with which he can only become acquainted by separate examination of each distinct locality. The theory of Evolution, if it could be absolutely proved to be true, would give us such a general view of the progressive work of creation. But the proof has not yet been given, and perhaps may be unattainable; therefore, no one has a right to insist upon the acceptance of the theory, much less to make it (as Haeckel and his friends would force mankind to do) a sort of new religion, or, rather, a substitute for all religion. It may be that this theory is true. It certainly appears to be supported by a large number of facts of very great interest, collected from nearly every part of the field of observation; and, if proved to be true, it is to be welcomed by everyone who loves the truth. But, like the view of our island explorer, the range is still bounded by the inevitable horizon. Our theory applies only to the things of time and sense. Within these bounds all knowledge seems to point to continual progress and unceasing change. Every form of existence with which we are acquainted doubtless has a history, though we may not be able to scan it. Not only each atom and molecule,—not only every individual of the countless myriads of living things,—but every mass of heterogeneous materials, from the smallest pebble of the earth or the cosmic dust of the heavens, to the mightiest sun of the universe, has its past, present, and future, upon which we may exercise our powers of thought, and by means of various processes of observation and examination may gain some knowledge of their nature and history. The terms "new" and "old" apply to all material things. Even the vast masses of revolving matter, of which the stars consist, are subject to the apparently universal law of change of condition. Not only the planets—the comparatively insignificant attendant stars of each solar system—but the very suns themselves are growing old;—no new truth, as you will justly say, since it was familiar to an ancient poet, who thus addressed the Creator of all: "Of old hast Thou laid the foundation of the earth; and the heavens are the work of Thy hands. They shall perish, but Thou shalt endure; yea, all of them shall wax old like a garment. . . . . But Thou art the same, and Thy years shall have no end."* Of this truth, so long ago perceived and acknowledged by man, a striking illustration has been afforded by the results of recent investigations in a new branch of science, which has been called "stellar chemistry." A few years only have elapsed since the invention of the spectroscope, but marvellous, indeed, are the revelations obtained by

* Psalm cii., 25-27.

means of that instrument in the hands of skilful observers. In a paper published in the *Nineteenth Century* for February, Mr. Norman Lockyer presents us with a portion of the results of the last ten years' work in this branch of science. From the one hundred thousand observations recorded by him, he deduces the wonderful fact, that the fixed stars may be roughly divided into four classes, distinguished by their (presumed) difference in temperature. He shows that the brightest and hottest of the stars have a spectrum, "marvellously simple," indicating in the main only two substances, hydrogen and calcium, with faint traces of magnesium, and perhaps of sodium. Stars of the second-class are neither so bright nor, it is believed, so hot. In this class our own sun is included, though even his temperature is spoken of by Mr. Lockyer as so great as to be "beyond all definition.' Stars of this class give a spectrum in which the indications of hydrogen are distinctly enfeebled; the evidences of the existence of calcium are increased in intensity, as are also the indications of sodium and magnesium; while the simple character of the spectrum of the first-class has been replaced by a combination of lines of "terrible complexity." In speaking of the other two classes of suns, I will quote Mr. Lockyer's own words:—"The complexity which we meet with in passing from the first-class to the second, is one brought about by the addition of the lines produced by bodies of chemical substances of moderate atomic weight. The additional complexity observed when we pass from the second to the third, is brought about by the addition of lines due in the main to bodies of higher atomic weight, and—this is a point of the highest importance—at the third stage," that is, in the third-class of suns, "the hydrogen, which existed in such abundance in stars of the first-class, has now entirely disappeared. In the last class of stars to which I have referred, the fourth, the lines have given place to fluted bands, at the same time that the light and colour of the stars indicate that we have almost reached the state of extinction." Mr. Lockyer puts the same facts in simpler form, thus—

1. The hottest stars show lines of.. H + Ca + Mg
2. The sun H + Ca + Mg + Na + Fe
3. The cooler stars Mg + Na + Fe + Bi + Hg
4. The coolest; fluted bands of metals and metalloids.

In the cooler stars the elements are found in a state of greater combination, while in the hottest they are dissociated by the intense heat, so that the older (and therefore cooler) a star has become, the less of free hydrogen will appear. On the earth the process of cooling has reached the stage in which hydrogen is no longer found in a free state. All that is here stated from Mr. Lockyer's paper, though extremely interesting in the connection in which I have introduced it, occurs in the original as part of the reasoning which leads to the conclusion that many of the substances which have hitherto been regarded as elementary are probably compounds, capable of dissociation at the transcendental temperatures which exist in the hotter kinds of stars. Thus a general law is indicated which may be expressed in these words:—*The lowering of temperature in a mass of matter is accompanied by a gradually increasing complexity of chemical forms:* and, of course, the converse holds good that *the higher the temperatnre the more completely will the elements which form the chemical compounds be dissociated.*

Before passing from this subject, it will not be out of place to express the opinion that we have here one of the greatest discoveries of these days, and one which opens out a new field of investigation to which it is not easy to assign a limit.

I had intended to call your attention to the remarkable progress which has lately been made in other branches of science and in the application of science to the comfort and convenience of man, but time will not permit more than a passing

allusion to the strenuous efforts of many inventors to utilize the electric light, to the wonders of the telephone, the microphone, and the phonograph, and to the improvements in telegraphy, the latest of which, by Mr. E. A. Cowper, has made it possible to send one's autograph by electricity, so that it will no longer be ridiculous to say, "I know who sent this telegram, for I recognize the hand-writing." I can but glance at the success which has crowned the efforts of two distinguished physicists, Messrs. Cailletet and Pictet, to compress into the fluid form the so-called permanent gases, so that even hydrogen has been seen in the form of a fluid metal; or at the remarkable achievement of the masters in experimental chemistry, who have succeeded in putting together the molecules which form the colouring matter of indigo and madder; or at the penetration which has seen the cause of the irritating and cough-producing dry fog of huge cities in the condensed vapour of hydro-carbons, derived from coal smoke, by which the minute globules of water, of which the fog consists, are coated, and so kept on the one hand from readily coalescing, and, on the other, from dissolving in the air, even though the hygrometric condition of the atmosphere be reduced considerably below the point of saturation.

One cannot take up a scientific periodical without finding a record of advance in one or more of the many branches of scientific research, or of application of known facts. Many and diligent are the workers in the study of nature in the fullest meaning of the word as applied to the whole material world. Great has been the work accomplished. Great has been the gain of real knowledge of the material things by which we are surrounded, and in the midst of which we have to do our part as best we may, ever acting upon and affected by those among whom our lot is cast for the few short years of our present state of existence. Of what is to follow, and how to prepare for the great future which every man naturally looks for, science, however exalted, is, and must remain, absolutely silent. Thus far, and no farther, may she come. Here sight and hearing, speech and thought, avail no more. Science has no instruments to sound the unknown depth, to scale the unknown height, or to measure the length and breadth of the Infinite; but great is the joy, and boundless the hope of him who has learned to believe that what is denied to the bodily faculties is permitted to the living spirit, and thus, whatever his present misery may be, he endures, "as seeing Him who is invisible," and calmly awaits the day when Love, which lives for ever, will carry him safely across the unbridged gulf and set him in the eternal home of the great Father of all.

I cannot conclude this address better than by quoting a passage by Victor Hugo which appears in the *Contemporary Review* for March last, as follows:—

"Let us not forget, and let us teach it to all, that there would be no dignity in life,—that it would not be worth while to live, if annihilation were to be our lot. What is it which alleviates and which sanctifies toil, which renders men strong, wise, patient, just, at once humble and aspiring, but the perpetual vision of a better world, whose light shines through the darkness of the present life? For myself, I believe profoundly in that better world; and after many struggles, much study, and numberless trials, this is the supreme conviction of my reason, as it is the supreme consolation of my soul. * * * There is a misfortune of our times, I could almost say there is but one misfortune of our times; it is a tendency to stake all on the present life. By giving to man, as a sole end and object, the material life of this world, you aggravate its every misery by the negation which awaits him at the end; you add to the burdens of the unfortunate the insupportable weight of future nothingness; and that which was only suffering, that is to say, the law ordained of God, becomes despair, the law imposed by hell. Hence

our social convulsions. Assuredly, I am one of those who desire, I will not say with sincerity, for the word is too feeble, but who desire with inexpressible ardour, and by all means possible, to ameliorate the lot of all who suffer; but the first of all amelioration is to give them hope. How greatly lessened are our finite sufferings when there shines into the midst of them an infinite hope! The duty of us all, whoever we may be, legislators and bishops, priests, authors, and journalists, is to spread abroad, to dispense and to lavish in every form the social energy necessary to combat poverty and suffering, and at the same time to bid every face to be lifted up to Heaven, to direct every soul and mind to a future life, where justice shall be executed. We must declare with a loud voice that none shall have suffered uselessly, and that justice shall be rendered to all. Death itself shall be restitution. As the law of the material universe is equilibrium, so the law of the moral universe is equity. God will be found at the end of all."

1. "Notes on a Disease among Sheep in the Waikato District," by Major W. G. Mair.

In mid-summer, 1877-8, sheep in Upper Waikato were affected by a disease hitherto unknown to sheep-breeders in the district. The symptoms were described as being not unlike those caused by eating ergotized grass, viz., throwing up the head, jerking it suddenly to one side, then staggering back and falling. These symptoms suggested an affection of the brain, and upon some of the sheep being killed for examination, one or more maggots were, in every instance, found apparently eating through the substance of the brain; in some cases smaller maggots were found in the nasal passages, indicating that it was by the nostril that the parasite found its way into the sheep's head! In one instance, an unusually large maggot was found under the base of the tongue. I could not ascertain whether any sheep had died from this disease, and many well-conditioned animals were found, upon being slaughtered, to be infested by these parasites. The maggots are in some instances fully three-quarters of an inch in length by half an inch in breadth; the colour is a dirty white, with two triangular black spots at the nether extremity.

When placed upon a smooth surface they travel with a brisk undulating motion like that of the caterpillar, and they are very retentive of life, being quite lively after three days' imprisonment in a match-box. I have no idea what the perfect insect may be like, but there was a fly common about sheep yards at the time when these observations were made, and as it appears to be new, it is possible that it may be the one which deposits the maggots, either in the sheeps' nostrils, or in their food.

I am indebted to Messrs. Kirk and Connell, of the Armed Constabulary, for the greater part of my information.

Several members pointed out that the disease described by the author was due to the *Œstrus*, or Gad-fly, which appears to be increasing in numbers in New Zealand.

2. "On the Occurrence of the Genus *Sporadanthus* in New Zealand," by T. F. Cheesman, F.L.S. (*Transactions*, p. 324.)

3. "On the Habits of *Prionoplus reticularis*, with Diagnoses of the Larva and Pupa," by Capt. T. Broun. (*Transactions*, p. 284.)

Mr. Cheeseman exhibited, on behalf of Capt. Broun, specimens of the larva and pupa of *Prionoplus*, and pieces of timber perforated by the larva.

Second Meeting. 30*th June*, 1879

Dr. Purchas, President, in the chair.

New Members.—T. W. Gudgeon, C. H. Haines, M.D., F.R.G.S., C. T. Hetley, J. McElwaine, John Reid, J. H. Upton, E. S. Wilcocks.

1. "Notes on the Growth of certain Trees on Scoria Soil near Mount Eden, Auckland," by Mr. Justice Gillies. (*Transactions*, p. 357.)

2. "On the Botany of the Pirongia Mountain," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 317.)

3. "On the Mound-builders of North America," by J. Adams, B.A.

This paper was illustrated by a collection of crania, pottery, stone adzes, arrow-heads, etc., taken from mounds in Illinois, and presented to the Museum by Mr. H. N. Rust, of Chicago.

Third Meeting. 27*th July*, 1879.

Dr. Purchas, President, in the chair.

New Members.—J. Alexander, E. Burgess, C. La Roche.

1. The Secretary read a letter from Mr. W. Atkins in reference to the growth of trees in clay soils near Auckland. He pointed out that many of the Coniferæ enumerated by Mr. Justice Gillies in his recent paper on the growth of trees on volcanic soils, do equally well on stiff clay soils, provided that care is taken to prevent water stagnating about the roots while the trees are young. Mr. Atkin also alluded to the death of many trees near Auckland from the supposed attacks of a fungus on the roots, as a subject worthy of enquiry.

2. "The possible Pacification of the World by means of a rational International Policy," by the Rev. S. Edgar.

3. "The Distress in England; its Causes and Remedies," by J. C. Firth.

4. Dr. Purchas exhibited a number of trenails taken from the schooner "Kenilworth," now being repaired at Auckland. The greater number of the trenails in the vessel were eaten in a spiral manner on the outside by the larva of some beetle, so that many were quite loose in the planking. None of the Auckland ship-builders were acquainted with a similar case. The vessel was twelve years old, and for the last nine had been trading in the Malay Archipelago and South Sea Islands.

Fourth Meeting. 1*st September*, 1879.

Dr. Purchas, President, in the chair.

New Members.—J. A. O. Gibbes, E. Porter, C. H. Street.

1. "Concerning Alcohol," by E. A. Mackechnie.

2. "Notes on the Rise and Progress of Architecture and the Fine Arts generally," by Albin Martin.

Fifth Meeting. 29*th September*, 1879.

Dr. Purchas, President, in the chair.

New Member.—K. Watkins.

1. A long discussion took place on Mr. Mackechnie's paper on "Alcohol," read at the last meeting.

2. "On the Distress in England; its Causes and Remedies, being a Reply to Mr. Firth's Paper on the same Subject," by the Rev. S. Edgar.

Mr. Firth replied at some length in defence of his paper.

Sixth Meeting. 27*th October*, 1879.

Dr. Purchas, President, in the chair.

New Member.—W. W. Taylor.

1. The President read a letter from Mr. B. S. Booth giving some interesting information respecting the American "Horned Frog" *(Phrynosoma blainvillii)*.

2. "Description of the Larva of *Pericoptus truncatus*, with Observations as to Habitat," by Captain T. Broun. (*Transactions*, p. 288.)

3. "On Landscape Art in the Province of Auckland," by K. Watkins.

4. Mr. Cheeseman exhibited and made some remarks on some specimens of *Lepidosiren* and other fishes lately added to the Museum collections.

Annual General Meeting. 16*th February*, 1880.

The Rev. A. G. Purchas, President, in the chair.

New Members.—J. E. Macdonald, A. G. Murray Moore, M.D., H. A. Watt, J. L. Wilson, W. S. Wilson.

The minutes of last annual general meeting, held 17th February, 1879, were read and confirmed.

ABSTRACT OF ANNUAL REPORT.

Twenty-two names have been added to the register during the year, but there is only a slight increase in the total number of members. Six meetings have been held during the session, at which fifteen papers were read. The attendance was fair considering the difficulty experienced in obtaining a full supply of papers for reading.

The Council acknowledge the receipt of a grant of £45 10s. under the provisions of "The Public Libraries Subsidies Act." This amount has been expended in the purchase of standard scientific works. The Council received from Mr. J. T. Mackelvie a complete set of the publications of the "Royal Geographical Society," some 75 volumes in all.

The annual balance-sheet showed the receipts to be £454 15s. 1d., including the balance of £29 9s. 1d. carried from last year's accounts. The expenditure amounted to £436 16s. 3d.

Election of Officers for 1880:——*President*—F. D. Fenton; *Council*—G. Aickin, Rev. J. Bates, J. L. Campbell, M.D., J. C. Firth, Hon. Col. Haultain, Neil Heath, F.G.S., E. A. Mackechnie, J. A. Pond, Rev. Dr. Purchas, J. Stewart, M.Inst.C.E., S. P. Smith; *Auditor*—T. Macffarlane; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

First Meeting. 13*th February*, 1879.

Professor Bickerton, President, in the chair.

1. "Partial Impact (Paper No. 3): On the Origin of the Visible Universe," by Professor A. W. Bickerton, F.C.S., President. (*Transactions*, p. 175).

Discussion on this paper was postponed to the next meeting.

Second Meeting. 27*th February*, 1879.

Professor Bickerton, President, in the chair.

New Members.— M. Morrison, W. G. Brittan, C. G. Andrews, J. F. Harper, A. Anderson, J. Goodall, C.E., Dr. J. A. Wardle, E. Watkins, J. Hay, J. A. Mollet, J. Hewett, J. Curnow, LL.B., T. J. Joint, W. H. Symes, M.D., M. Chilton, J. Curtis, A. Cuff, F. Trent, J. Trent, Rev. — Wilkes, C. H. Wiggins, C. Napier Bell, C. W. Walkden, R. W. Thomas, J. Ollivier, H. Thomson, E. Deacon, J. P. Jameson, J. S. Jameson, W. Jameson, E. C. J. Stevens, M.H.R., T. S. Cleminshaw, J. Evans Brown, M.H.R., G. Booth, John Bell, Rev. H. C. M. Watson, J. Murphy, Rev. R. Otway, H. Hanmer, S. S. Field, J. W. Parkerson, W. Pratt, Alex. Rose, A. W. O'Neil, Geo. Bowron, E. Eckford, H. W. Purdie, A. C. Newton, J. H. Baker, D. H. Monro, Fred. Adams, J. Kelly, Arthur Templer, S. Anstey, Arthur P. Marton, F. C. L. Symonds, C. B. Shanks, J. O'Brien, A. R. Forbes, J. Williams, H. L. White, Chas. Forbes.

Professor Bickerton then vacated the chair.

1. "Partial Impact (Paper No. 4): On the General Problem of Stellar Collision," by Prof. A. W. Bickerton." (*Transactions*, p. 181.)

A long discussion followed on this and the previous paper.

Third Meeting. 6*th March*, 1879.

Professor Bickerton, President, in the chair.

The Hon. Secretary announced his resignation.

New Members.—W. Collins, A. Jamieson, F. Graham, J. S. Lambert, Rev. J. Cumming, W. D. Wood, J. P. Restell, Sydney J. Dick, A. M. Cooper, Mrs. Inglis, Miss Edgar, Miss Connon, Miss Grierson, Miss Hamilton, Miss Dunnage.

1. "On a Universal Code of Signals," by C. W. Adams.

FOURTH MEETING. *3rd April*, 1879.

The annual conversazione was held on April 3rd, in the Provincial Council Chambers. There was a large attendance of members and their friends.

1. The President, Prof. Bickerton, delivered the opening address, being a paper entitled "On the Genesis of Worlds and Systems." (*Transactions*, p. 187.)

FIFTH MEETING. *1st May*, 1879.

Professor Bickerton, President, in the chair.

Mr. Nelson K. Cherrill was appointed Hon. Secretary. A vote of thanks to Mr. J. S. Guthrie, the retiring secretary, was carried.

New Members.—Robert Loughnan, R. M. Cotton, C.E., W. G. Meddings, A. J. Merton, — De Montalk.

SIXTH MEETING. *5th June*, 1879.

Professor Bickerton, President, in the chair.

New Members.—Rev. J. Elmslie, W. H. Simms, J. H. Twentyman, R. M'Connal, C. H. Williams, N. G. Barnett, A. D. Austin, F.R.A.S.

1. "Further Notes on New Zealand *Coccidæ*," by W. M. Maskell. (*Transactions*, p. 291.)

2. "Description of a new (?) Genus and Species of Butterfly of the Sub-family *Satyrinæ*," by R. W. Fereday, C.M.E.S.L. (*Transactions*, p. 264.)

3. Mr. C. W. Adams drew the attention of members to some curious facts relating to musical tones in the notes of some of the Australian birds.

SEVENTH MEETING. *3rd July*, 1879.

Professor Bickerton, President, in the chair.

New Members.—Capt. Raymond Brown, J. M. Heywood, Rev. J. N. Binsfield, W. H. Floyd, — Izard, G. F. Ritso.

1. "On the Birth of Nebulæ," by Professor A. W. Bickerton, F.C.S. (*Transactions*, p. 197.)

EIGHTH MEETING. *7th August*, 1879.

Professor Bickerton, President, in the chair.

New Members.—R. Allan, A. Thompson, J. Seager, J. Armstrong, J. J. Patterson, Wm. J. Bull, C.E.

1. "Notes on an Ancient Manufactory of Stone Implements at the Mouth of the Otaki Creek, Brighton, Otago," by Professor Julius von Haast, Ph.D., F.R.S., Director of the Canterbury Museum. (*Transactions*, p. 150.)

2. "Notes upon the Height of Mount Cook," by C. W. Adams.

According to the author's observations the height is 12,375 feet.

NINTH MEETING. *4th September*, 1879.

Professor Bickerton, President, in the chair.

New Member.—Dr. J. H. Townend.

1. "Notes on the Colour Sense of the Maori," by the Rev. James W. Stack. (*Transactions*, p. 153.)

2. "Remarks on Mr. McKenzie Cameron's Theory respecting the Kahui Tipua," by the Rev. J. W. Stack. (*Transactions*, p. 159.)

TENTH MEETING. *2nd October*, 1879.

J. Inglis, Vice-president, in the chair.

1. "A short Sketch of the Flora of the Province of Canterbury, with Catalogue of Species," by J. B. Armstrong. (*Transactions*, p. 325.)

ANNUAL GENERAL MEETING. *6th November*, 1879.

Professor Bickerton, President, in the chair.

ABSTRACT OF ANNUAL REPORT.

During the year 103 new members were elected, making the total number at the present time 219.

Thirteen papers were read, and a series of seven popular lectures given:—On Pictorial Art, by Professor von Haast; on Artificial Illumination, by Professor Bickerton; on the Modern Magic Lantern, by Mr. Cherrill; on the Modern Manufacture and Economic Consumption of Gas, by Mr. Cleminshaw; on Constructive Art in the Homeric Age, by Mr. E. Dobson; on Astronomy, by Professor Bickerton; on the Maori, by the Rev. Mr. Stack.

The Microscopical section did a large amount of work, but suffered a severe loss in the death of its chairman, Dr. Powell, who was an active supporter of the Society, and a frequent contributor to its Proceedings.

The accounts show total receipts for the year as £321 19s. 7d., while a balance remained in hand of £52 17s. 2d. Among the items of expenditure were £106 7s. 6d. for books, £43 17s. for the Arundel Society Pictures, and £30 for purchase of specimens of Ceramic Art at the Sydney Exhibition.

Election of Officers for 1880:—*President*—E. Dobson, C.E.; *Vice-presidents*—Professor Julius von Haast, F.R.S., the Rev. J. W. Stack; *Council*—Professor Bickerton, R. W. Fereday, J. Inglis, A. D. Dobson, G. Gray, J. S. Lambert; *Hon. Treasurer*—W. M. Maskell; *Hon. Secretary*—Nelson K. Cherrill.

Twelfth Meeting. 26*th Novvmber*, 1879.

E. Dobson, C.E., President, in the chair.

New Members.—Thos. Gordon, James Hamilton, C. Blakewell, Edwin Rayner, Mrs. P. Hanmer.

A vote of thanks was passed to Professor Julius von Haast for the very able manner in which he had expended, at Sydney, the fund which had been placed at his disposal, as shown hy the very fine collection of Ceramic Art before the meeting.

1. "Description of a (?) new Species of the Family *Leucanidæ*, and a (?) new Species of the Genus (?) *Chlenias*," by R. W. Fereday, C.M.E.S.L. (*Transactions*, p. 267.)

2. "Notes on *Ziphius* (*Epiodon*) *novæ-zealandiæ*, von Haast, Goose-beaked Whale," by Professor Julius von Haast, Ph.D., F.R.S., Director of the Canterbury Museum. (*Transactions*, p. 241.)

3. Professor von Haast then explained to the meeting the special points of interest connected with the collection of Ceramic and Industrial Art Specimens which he had brought from Sydney, and read a letter from Japan, descriptive of the mode of manufacture adopted to produce the various styles of porcelain.

OTAGO INSTITUTE.

First Meeting. 13*th May*, 1879.

Professor Hutton, President, in the chair.

New Members.—James Ashcroft, Rev. A. R. Fitchett, Dr. Macdonald, Thomas Lusk, J. Ulbrick, A. Kerr (Oamaru).

The Rev. Professor Salmond gave a lecture entitled, "A Criticism of Herbert Spencer's 'First Principles.'"

Second Meeting. 10*th June*, 1879.

Professor Hutton, President, in the chair.

New Members.—Chas. Hogg, B.A.; Rev. M. W. Green.

Mr. J. S. Webb gave a lecture on "The Unseen Universe."

Third Meeting. 24*th June*, 1879.

Professor Hutton, President, in the chair.

The Rev. Dr. Roseby gave a lecture on "Socialism, an Appeal to First Principles."

Fourth Meeting. 15*th July*, 1879.

Professor Hutton, President, in the chair.

New Members.—Rev. Professor Salmond, R. Knowles, G. M'Kinnon (Port Chalmers).

1. "The *Diptera* of New Zealand,"* by Prof. Hutton.

[* This catalogue has, with the author's consent, been reserved by the Board of Governors, in order that it may be published uniform with the series of Natural History publications issued from the Colonial Museum.—Ed.]

Fifth Meeting. *5th August*, 1879.

Professor Hutton, President, in the chair.

The Rev. J. Upton Davis gave a lecture on "George Eliot's Poems."

Sixth Meeting. *14th October*, 1879.

Professor Hutton, President, in the chair.

New Member.—W. S. Fitzgerald.

1. "Notes on the Southern Stars and other Celestial Objects," by J. H. Pope. (*Transactions*, p. 165.)

2. "Contributions to the *Cœlenterate* Fauna of New Zealand," by Professor F. W. Hutton. (*Transactions*, p. 274.)

3. "Additions to the List of New Zealand Worms," by Professor Hutton. (*Transactions*, p. 277.)

4. "Contributions to the Entomology of New Zealand," by Professor Hutton. (*Transactions*, p. 272.)

5. "On *Anas gracilis*, Buller," by Professor Hutton. (*Transactions*, p. 271.)

6. "On the New Zealand Frog," by Dr. Fitzinger; translated from the Zoology of the Voyage of the 'Novara,' by Professor Hutton. (*Transactions*, p, 250.)

7. "Descriptions of new Star-fishes from New Zealand," by Professor A. E. Verrill. (From the Transactions of the Connecticut Acad., 1867.) Communicated by Professor Hutton. (*Transactions*, p. 278.)

Annual General Meeting. *10th February*, 1880.

W. N. Blair, Vice-president, in the chair.

New Member.—H. P. Higginson.

1. "Description of a New Fish," by Professor Hutton.

LABRICHTHYS ROSEIPUNCTATA.

D $\frac{9}{11}$; A $\frac{3}{10}$; L lat. 27; L trans. 3/9.

A posterior canine tooth and two anterior canine teeth in the upper jaw. Cheeks with five or six series of scales.

Back and head brownish pink; throat white; sides yellowish white, with six narrow longitudinal bands of yellow-pink; a broad dusky transverse streak at the end of the tail. Dorsal fin not scaly at the base, with numerous small bright pink spots; anal with a few yellow spots near the

base; caudal lunulate, tinged yellowish; pectorals yellowish. Total length 6 inches.

Dunedin, 15th December, 1879.

The species is closely allied to *L. coccineus*, Forster, but differs in colour. The type is preserved in the Otago Museum.

2. "Notice of the Occurrence of a Species of *Hemiphues* in New Zealand," by D. Petrie, M.A. (*Transactions*, p. 355.)

3. "Description of a new Species of *Ehrharta*," by D. Petrie, M.A. (*Transactions*, p. 356.)

4. "Notice of the Occurrence of *Liparophyllum gunnii* in New Zealand," by D. Petrie, M.A. (*Transactions*, p. 354.)

Election of Office-bearers for 1880:—*President*—Dr. Hocken; *Vice-presidents*—Professor Ulrich, D. Petrie, M.A.; *Hon. Secretary*—Geo. M. Thomson; *Hon. Treasurer*—H. Skey; *Auditor*—D. Brent, M.A.; *Council*—W. Arthur, C.E., W. N. Blair, C.E., A. Montgomery, R. Gillies, F.L.S., W. Macdonald, LL.D., Bishop Nevill, D.D., J. S. Webb.

ABSTRACT OF ANNUAL REPORT.

Seven meetings were held during the session, at four of which popular lectures were delivered. At the ordinary meetings twelve papers were read.

In connection with the Field Naturalists' Club Mr. G. M. Thomson delivered a course of 11 lectures on Elementary Botany, which were largely attended.

During the year, fourteen new members joined. The Council express regret at the death of Mr. Peter Thomson, an active member. Valuable additions have been made to the library.

The balance-sheet shows that the revenue for the past year amounted to £229 10s. 2d. (including a balance from the previous year of £58 7s. 2d.) The expenditure amounted to £216 12s. 4d., of which £25 2s. 6d. was paid to the funds of the New Zealand Institute towards the expense of printing Volume XI. of the Transactions of the New Zealand Institute, leaving a balance in the hands of the Treasurer of £12 17s. 10d.

The Reserve Fund of the Institute, invested in the Government Savings' Bank, amounts to £106 12s.

WESTLAND INSTITUTE.

ANNUAL GENERAL MEETING. *10th December*, 1879.

Dr. Giles in the chair.

ABSTRACT OF ANNUAL REPORT.

The Committee report a large decrease in the number of members, the number for 1878 having been 167, while for 1879 it was only 115.

During the year twelve ordinary and two special meetings were held.

The Society received from the Board of Education £96 7s., being a part of the £5000 voted by Parliament for subsidies to public libraries.

A sum of £18 has been expended on books, and the Library will contain, when they arrive from London, about 2170 volumes.

A list of donations to the Museum and Library is appended.

The accounts show that the total receipts amounted to £125 10s., the whole of which was spent on the Library and Museum, and that the balance to the credit of the Society was £21 16s.

ELECTION OF OFFICERS FOR 1880:—*President*—His Honour Judge Weston; *Vice-president*—Dr. Giles, R.M.; *Committee*—Dr. James, J. Pearson, J. Nicholson, H. L. Robinson, R. W. Wade, D. M'Donald, J. Anderson, T. O. W. Croft, C. E. Tempest, F. A. Learmonth, J. H. Hankins, A. H. King; *Hon. Treasurer*—W. A. Spence; *Secretary*—Richard Hilldrup.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

Annual General Meeting. *3rd February*, 1879.

The Right Rev. the Bishop of Waiapu, Vice-president, in the chair.

New Members.—Dr. T. Hitchings, J. W. Carlile.

Election of Officers for 1879:—*President*—The Right Rev. the Bishop of Waiapu; *Vice-president*—Dr. Spencer; *Hon. Secretary and Treasurer*—W. Colenso; *Council*—Messrs. Bold, Colenso, Kinross, Locke, M. R. Miller, Smith, Sturm; *Auditor*—T. K. Newton.

ABSTRACT OF ANNUAL REPORT.

During the past winter session six ordinary meetings were held, at which eleven papers by members were read.

The number of members is 74, being an increase on the previous year.

During the last year several Zoological, Botanical, and Geological Specimens have been collected by the members of the Institute for the Museum.

The audited statement of accounts shows a balance of £210 19s. 7d. remaining to the credit of the Institute after paying for all its ordered books.

First Meeting. *12th May*, 1879.

Dr. Spencer, Vice-president, in the chair.

1. "Note and Description of a possibly new Species of *Aplysia*," by F. H. Meinertzhagen. (*Transactions*, p. 270.)

The paper was illustrated with both wet and dry specimens of that mollusc.

2. "Notes and Observations on the Animal Economy and Habits of one of our New Zealand Lizards, supposed to be a new Species of *Naultinus*," by W. Colenso, F.L.S. (*Transactions*, p. 251.)

The Hon. Secretary also exhibited three living specimens of this animal to illustrate his paper.

Second Meeting. *9th June*, 1879.

The Right Rev. the Bishop of Waiapu, President, in the chair.

1. "Contributions towards a better knowledge of the Maori Race," by W. Colenso, F.L.S. (*Transactions*, p. 108.)

This was the *second* of a series intended by the author on this subject. An interesting discussion followed.

Third Meeting. 14*th July*, 1879.

The Right Rev. the Bishop of Waiapu, President, in the chair.

1. "The Influence of Forests on Climate and Rainfall," by F. S. Peppercorne, C.E. (*Transactions, p.* 24.)

2. The Hon. Secretary read an interesting, lately printed, paper by the Director of the Botanical Gardens, Adelaide.—"On the Vegetable Fragments found in the Tombs and other Monumental Buildings of the Ancient Egyptians."

Fourth Meeting. 11*th August*, 1879.

Dr. Spencer, Vice-president, in the chair.

The Honorary Secretary gave "an outline memoir of the two brothers Allan and Richard Cunningham, who were both early botanists and discoverers in New Zealand, and whose names are intimately bound up with the Flora of this Colony, as well as with that of the neighbouring Australian Colonies. This narration was supplemented by extracts from Mr. Allan Cunningham's letters to Mr. Colenso, and by a few prominent characteristic passages concerning the two brothers, from botanical and other works little known in New Zealand, and also by portraits of the two unfortunate brothers, who may truly be said to have been martyrs to their favourite science—botany."

From among the many reasons which prevailed with Mr. Colenso to bring this subject before the meeting, the following (mentioned by him) may be particularly noticed:—(1.) The two Cunninghams forming a connecting scientific link in the New Zealand field with those scientific men who accompanied Cook hither on his expeditions; both the Cunninghams having been well-known to Sir Joseph Banks, through whom they also individually received their respective appointments as Government Botanists to New South Wales. (2.) Mr. Colenso's personal knowledge of, and intimate friendship with, the lamented Allan Cunningham. And (3.) Their many striking discoveries in New Zealand at an early date, which deserve being duly remembered.

Fifth Meeting. 4*th September*, 1879.

The Right Rev. the Bishop of Waiapu, President, in the chair.

1. "A few Remarks on a Cavern near 'Cook's Well,' at Tolaga Bay, and on a Tree (*Sapota costata*) found there," by W. Colenso, F.L.S. (*Transactions*, p. 147).

Several botanical and other specimens were exhibited.

2. Mr. Colenso gave an account of the Maori myth of "*Kae* and the Pet Whale of *Tinirau*;" illustrating the same with similar legends (as to tame whales=*Delphinus* sp.) from ancient Greek and Roman history, Pagan and Christian.

Sixth Meeting. 13*th October*, 1879.

The Right Rev. the Bishop of Waiapu, President, in the chair.

1. "On the Moa (*Dinornis*), Part II.," by W. Colenso, F.L.S. (*Transactions*, p. 63.)

This paper was illustrated by bones and plates of the Moa; also some "Moa stones" from Porangahau; and ancient Maori fish-hooks, made out of Moa bone, from the East Cape.

Several specimens of New Zealand land shells (*Helix* and *Bulimus* species), collected by Messrs. Colenso, W. Chambers, and H. Nairn; of *Dendrite*, collected by Mr. P. Dolbel; and also some early pencil sketches (1837-9) by Mr. Colenso, and other mementos of Old New Zealand, were exhibited.

Living plants of *Drosera auriculata* (raised by the Hon. Secretary) were also shown; and an outline given of some recent interesting experiments by Mr. F. Darwin, on an allied English species (*Drosera rotundifolia*), to illustrate the said plants.*

2. "A Description of a few new Plants from our New Zealand Forests, with dried Specimens of the same," by W. Colenso, F.L.S. (*Transactions*, p. 359.)

The dried specimens of the genera *Clematis*, *Metrosideros*, *Olearia*, *Dicksonia*, *Hymenophyllum* and *Trichomanes*, were exhibited. These caused much interest, particularly the *Clematis* and two small ferns (*Hymenophyllum* and *Trichomanes*), and elicited some discussion.

Council Meeting. *7th October*, 1879.

The President in the chair.

Ordered, That the books formerly selected, to the amount of £50, be purchased forthwith.

Council Meeting. *13th October*, 1879.

The Right Rev. the Bishop of Waiapu, President, in the chair.

New Members.—Rev. de Berdt Hovell, H. Baker, M. S. Bell, J. Mackinnon, F. S. Peppercorne, E. F. Rich, T. White.

Captain W. R. Russell, M.H.R., was chosen to vote in the election of the Board of Governors for the ensuing year, in accordance with clause 7 of the New Zealand Institute Act.

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* Journal Linn. Society, Botany, Vol. XVII.

NEW ZEALAND INSTITUTE.

NEW ZEALAND INSTITUTE.

Eleventh Annual Report.

On the following dates meetings of the Board have been held since the publication of the last report—4th September and 10th December, 1878; 23rd January and 17th May, 1879.

The members who retired from the Board in compliance with the Act were Messrs. Travers, Waterhouse, and Mason, all of whom were re-appointed by his Excellency the Governor.

The following gentlemen were elected Governors by the Incorporated Societies, under clause 7 of the Act:—The Hon. Robert Stout, M.H.R.; Thomas Kirk, Esq., F.L.S.; Dr. Buller, C.M.G., F.R.S..

The undermentioned names were added to the list of honorary members of the Institute:—Professor Max Müller, the Rev. J. E. Tenison-Woods, and Professor Garrod, F.R.S.

The following list will show the number of members now on the roll of the Institute:—

Honorary Members	30
Ordinary Members:	
Auckland Institute	276
Hawke's Bay Philosophical Institute	74
Wellington Philosophical Society	251
Nelson Association	50
Westland Institute	133
Philosophical Institute of Canterbury	109
Otago Institute	212
Total	1,135

The volume (XI.) for the year was received from the publishers towards the end of May, and copies are now being distributed to the members of the Incorporated Societies, and those persons and institutions mentioned in the appended free list.

It has been found necessary this year, owing to the large increase in the number of members, which requires a corresponding increase in the number of volumes printed, to levy a proportional contribution from each society (under clause *d* of the regulations) of 2s. 6d. per volume, in order to meet

the cost of publication, the annual vote being now insufficient for that purpose.

Volume XI. contains 86 articles, and several short notices and abstracts which appear in the Proceedings, 19 plates, and 624 pages of letterpress.

The following are the sections of the work, as compared with last year's volume :—

	1879.	1878.
Miscellaneous	186 pages	190 pages.
Zoology	216 ,,	154 ,,
Botany	66 ,,	78 ,,
Chemistry	26 ,,	36 ,,
Geology	22 ,,	48 ,,
Proceedings	66 ,,	63 ,,
Appendix	42 ,,	60 ,,
	624 ,,	629 ,,

The volumes of Transactions now on hand are :—

Vol. I., second edition, 440; Vol. II., none; Vol. III., 8; Vol. IV., 6; Vol. V., 70; Vol. VI., 75; Vol. VII., 165; Vol. VIII., 33; Vol. IX., 170; Vol. X., 20.

The statement of accounts herewith shows a balance to the credit of the Board of £140 16s. 3d.

The annual reports of the several departments attached to the Institute are also appended.

James Hector, Manager.

Approved by the Board, 21st July, 1879.

Hercules Robinson, Chairman.

Museum.

The number of persons who visited the Museum during the year was 16,200; but, as many do not enter their names in the book kept for the purpose, this does not represent the actual number of visitors. The large attendance on Sunday afternoons shows that the privilege of visiting the building on that day is still appreciated by the public, 4,000 names being entered in the book for that day.

The collections added to the Museum number 12,339, of which 11,816 were collected by the officers of the Geological Survey, the remainder having either been presented, purchased, or received in exchange.

Herbarium.—No additions of any importance have been made to the collections, principally owing to the want of accommodation; and for the same reason the valuable collection of foreign plants from Kew, referred to in last report, is still inaccessible.

Natural History Collections.—Improvement has been made in the classification of the collections; but, still, it is found impossible to effect any proper systematic arrangement without additional space, more especially in the zoological section.

Mammalia.—The collections under this head have been re-arranged, and are now more conveniently placed for reference, full information regarding each order being given on tickets in the cases. Among the most important additions are a complete skeleton of *Delphinus forsteri*, obtained by purchase; the skull of the male *Dolichodon layardii*, presented by Dr. Muller, of Blenheim; and a collection of marsupiate animals from Kawau Island, presented by Sir George Grey.

Birds.—The chief additions in this branch are a black skylark (*Alauda arvensis*), presented by Mr. George Hall; a fawn-coloured variety of the native pigeon (*Carpophaga novæ-zealandiæ*), by Mr. Wise; a male lyre bird (*Menura superba*); and two specimens of the shy albatross, obtained by purchase. Dr. Buller records the first occurrence of this latter bird on the New Zealand coast in a paper in the Transactions of the New Zealand Institute, Vol X., p. 217 (1877). The collections under this section have increased very considerably, but cannot be fairly represented until further space is provided.

Reptiles.—Several fine specimens of the tuatara lizard (*Sphenodon punctatum*) have been received from Captain Fairchild, who obtained them on a rocky islet near Tauranga. A number of specimens of the more common kinds of lizard have also been received.

Fishes.—Although not many additions have been made to this class, some interesting specimens have been received—viz., *Trachichthys trailli*, collected by Mr. McKay, of the department; *Argentina decagon*, the type of Mr. Clark's new species; and *Trypterygium jenningsi* and *Notothenia parva*, new species from the Auckland Islands, described by Professor Hutton, of Dunedin.

Invertebrates.—A large collection, comprising Marine Mollusca, Sponges, Polyzoa, Crustacea, and Echinoderms, was obtained by Mr. T. W. Kirk, of the department, on the west coast of the North Island, and a collection of corals and shells from Japan was presented by Mr. H. S. Tiffen, of Napier. Many other interesting specimens were received, the principal being the beak, cuttle-bone, and suckers of a monster cuttle-fish, the body of which measured 11ft.

Ethnological.—The most interesting additions under this section are the head of a supposed Moriori god, carved in pumice, presented by Mr. A. Clough, of the Chatham Islands; a typical skull of the Polynesian race, by Dr. Hector; specimens of gritstone, used by the Maoris for grinding down

greenstone, by Mr. J. White; and specimens of Japanese paper-string, etc., by Mr. H. S. Tiffen, of Napier.

Minerals.—During the past year, about 300 specimens of minerals and rocks have been collected by the officers of the Geological Department. Among them are collections obtained by the Director, illustrating the progress of various mining ventures on the West Coast; from the Thames Gold-field, White Island, and Tuhua; and from the newly-discovered coal-fields on the west coast of the North Island. The Director also collected a number of mineral specimens of considerable interest during an examination of the auriferous district north of the Wakatipu Lake, in which quartz-reefing evinces a renewal of its former activity. Mr. Cox brought a collection of rocks from the Greenstone River, on Lake Wakatipu, and also several specimens of copper ore and magnetite from D'Urville Island. A very interesting and unique form of copper ore has also been obtained from Aniseed Valley, in connection with the Dun Mountain mineral belt, consisting of a granular serpentine, containing about 5 per cent. of metallic copper, dispersed through the mass of the rock in fine grains. This discovery, if followed up, may perhaps lead to some rich copper deposit, but at present it does not appear to be of much commercial importance. The greater number of the remaining specimens were collected by Mr. McKay from the mountainous district lying between Nelson and the Wairau River, and from various points along the Mount Arthur range. Amongst these are some valuable specimens of brown hæmatite from Mount Peel, containing 54 per cent. of metallic iron. This ore is associated with fine-grained breccias, dark slates, weathering white, and heavy beds of compact blue crystalline limestone, which overlie the great series of breccia beds and conglomerates which form the western part of the Mount Arthur range. It is largely developed in a north-westerly direction from Mount Arthur, striking in the direction of the ranges west of the Takaka Valley. At the place where the specimens were obtained, the bed might be about 50 feet thick, besides which isolated masses 10 feet to 15 feet across were observed occurring in the dark slates. North of the Takaka River a much greater development of the ore takes place, and diggers who have visited the locality report the deposit as being about a mile in width. It is probable that this deposit of brown hæmatite is a continuation of the Parapara ore; and, the specimens brought being taken from the surface, this ore when sunk upon will most probably change to red hæmatite, which, when pure, would contain about 70 per cent. of iron. Mr. M'Kay followed up this deposit for about three miles. Marbles of various qualities are represented from the Mount Arthur range, together with granites, hornblendic, eruptive, and serpentinous rocks associated with the Upper and Lower Silurian beds. To the same period should probably

be referred the beautiful white statuary marble and the dove-coloured "fortification" marble of Caswell Sound, on the west coast of Otago, which are now being placed in the market by a company that has been formed to work the quarries. The samples received in the Museum indicate it to be a marble of very superior quality for ornamental and building purposes.

The geology of the southern part of the Provincial District of Wellington has also received further illustration in the shape of a number of metalliferous and rock specimens, including specimens of iron, manganese, limestone, serpentinous and eruptive rocks; and from Jenkins' Hill, Nelson, another specimen of carbonate of iron, containing 40·8 per cent. of that metal, has been collected, thus adding another locality from which this valuable ore has been obtained. It occurs here under similar conditions to the ore of the same character previously described from Mr. Foote's colliery, at the Miranda Redoubt, and is associated with the coal measures.

Palæontology.—The fossil collections made during the past year by the staff of the Geological Survey Department, have been both large and important, and represent a great variety of formations ranging from recent times to Lower Silurian.

In the North Island the principal collections have come from the Miocene and Cretaceous beds developed on the West Coast in the Mokau District, while from the East Coast small but important collections have been made. In the Napier District, Mr. M'Kay succeeded in finding Ammonites in the chalk-marls of the Waipawa Gorge, thus confirming the Cretaceous age of the beds which had been previously assigned to them, chiefly on account of their mineral character. In the same district fresh-water deposits, containing fossils, were discovered on the banks of the Waipawa River; but it is yet uncertain whether these beds form part of the series underlying the Scinde Island beds, or were deposited in lakes, which were spread over the district after the last elevation of land in Pleistocene times.

Farther south in the Provincial District of Wellington the chief collections have been made from the tertiary beds which form high cliffs along the shore of Palliser Bay. The higher beds occurring in these cliffs contain Pleiocene fossils, and rest unconformably upon the Lower Miocene and Upper Eocene deposits below.

The only other discovery of importance in the North Island is the occurrence of the Mount Torlesse Annelid at Karori, in the neighbourhood of Wellington, which fossil, although widely distributed in the South, had not hitherto been found in the North Island.

The largest collections made during the past year come from the northern part of the Nelson province. From the Triassic rocks occurring at the Wairoa Gorge, and their south-west extension to Eighty-eight

Valley, the collections are as nearly as may be exhaustive. The difference between the fossils of the Oreti, Wairoa, and Otapiri series, which have a thickness of 8,000 feet, and represent the Trias formation in New Zealand, is far less than between the Oreti and Kaihiku series, several species found in the Oreti series being common to the Wairoa series, and one or two to the Otapiri series, while but one fossil is common to the Oreti and Kaihiku series.

Ammonites of the Jurassic and Liassic types are found, with *Nautilus reticularis*, in the lowest beds of the Middle Wairoa series; while Belemnites and Jurassic Terebratulidæ characterize the lower beds of the Otapiri series, the latter being again found in the lower beds of the Wairoa series. It is interesting to note the disappearance of *Spiriferina* of the *S. rostrata* group in the upper beds of the *Monotis* sandstone, its place being taken in the lower beds by the new genus *Psioidea*, *Spiriferina* again appearing in the Kaihiku beds as forms which in general outline closely resemble the Jurassic species. Not the least interesting discovery made in these beds is represented by a collection of plants from the lowest beds of the Otapiri series, immediately above the *Monotis* sandstone, in which a species of *Glossopteris* occurs. From the Kaihiku series (Permian) exactly the same fossils have been obtained which were found in Southland last year, only the forms are larger, and altogether form a more attractive collection.

Further collections were also made from the Carboniferous limestone, which has been shown to separate the Maitai slates from the Dun Mountain crystalline belt. Few additions to the species found last year have been obtained; but a choice collection of large and well-preserved *Spirifers*, as well as further specimens of *Productus* and corals, have been obtained.

In the western part of this district, the Upper Silurian rocks of the Baton River were largely collected from, and the following forms have been recognized:—*Calymene blumenbachii*, *Homalonotus knightii*, *Murchisonia terebralis*, *Avicula subplana*, *Modiolopsis modiolaris*, *Orthonota solenoides*, *Nucula levata*, *Spirifera radiata*, *Spirifera sulcata*, *Rhynchonella wilsoni*, *Atrypa reticularis*, *Orthis fissicostata*, *Orthis protensa*, *Strophomena corrugitella*, etc. These last beds rest unconformably upon a still lower fossiliferous series, from which Graptolites are reported to have come; but Crinoid remains, and one Coral, were all the fossils which could be obtained in this district. They must, however, from their position, be at least Lower Silurian in age.

A considerable collection was made from the Cretaceo-tertiary beds of the district, and some good specimens of Moa bones obtained from the caves on the table-land west of Mount Arthur.

The importance of correlating the geological formations of New Zealand with those of Australia, has rendered it necessary to devote a great deal of

time to the selection and thorough arrangement of a complete mineral and fossil collection, comprising over 2,000 specimens, for the Sydney Exhibition, from the stores of the Geological Department. This collection is to be illustrated by a special report, with maps and sections, bringing up the knowledge of the subject to the latest date, so as to furnish complete material for a conference with Australian geologists, the result of which may be of considerable advantage to this colony.

Publications.

The Museum and Laboratory Report, and the volume of Reports of the Geological Survey for last year, have been issued during the recess, and those for the current year are now ready for the press. A large amount of the material, both letterpress and plates, is in readiness for the first of a series of publications illustrative of the palæontology of New Zealand. The earliest-issued parts of this work will comprise the Fossil Flora and the Brachiopoda of the Lower Mesozoic formations. The illustrated work on the grasses of New Zealand, by Mr. Buchanan, is making good progress, considering the difficulties to be contended with in bringing out such an extensive and laborious work. Parts I. and II., comprising twenty-one folio plates, were issued last year, and Parts III. and IV. are now ready for the binder. The letterpress of the remainder of the work is now in the printer's hands, but some months will be required to complete the plates.

The whole of the work is being reprinted in a cheaper form, in octavo, for general circulation, the folio plates being reduced by photo-lithography as soon as impressions are obtained, so that the small-sized volume will be ready for issue immediately on the completion of the larger work.

The great advance in our knowledge of the natural history of the country, and the demand which exists on the part of students for the various descriptive catalogues that have been issued by the department, all of which are now out of print, have rendered the preparation of fresh editions necessary. A complete revision of the Mollusca, by Professor Hutton, will be the first of this series, and is now in the press. Dr. Buller has undertaken the production of a revised handbook of the Birds, and the necessary illustrations are in preparation.

A systematic work on the Fishes, embodying information of a more popular nature respecting the edible species, and very thoroughly illustrated by wood-cuts, is also in an advanced state, and arrangements have been made for completing the series in other sections of zoology.

A most valuable original work on the Coleoptera of New Zealand, by Captain Broun, has been placed at the disposal of the department for publication, and Government has authorized the necessary expenditure. This work, which has involved great labour in its preparation, contains descrip-

tions of 1,050 species of beetles, a large proportion of which are new. A leading naturalist has expressed his opinion that no country outside Europe and America has such a complete descriptive catalogue of this class of animal life, a thorough knowledge of which is of the utmost practical importance to the agriculturist.

A work descriptive of the economic minerals of New Zealand, embodying all the results of the work done in the Laboratory since its establishment —part of which only has hitherto been published—is being prepared for press with the assistance of Mr. Cox, and it is hoped may be issued some time during the year.

Meteorology.

Observations are taken continuously on a uniform system, by the use of registering instruments, at the following stations, fifteen in number:—Mongonui, Auckland, New Plymouth, Napier, Wanganui, Wellington, Nelson, Cape Campbell, Christchurch, Bealey, Hokitika, Dunedin, Queenstown, Wallacetown, Waitangi (Chatham Islands).

The observations are taken at 9·30 each morning, and are published in the following returns:—

1. At the end of the month the returns are completed and forwarded to the head office at Wellington, when, after having been examined, corrected, and reduced, the results are prepared for publication in the *Gazette*.

2. At the end of the year the monthly sheets from these fifteen stations are averaged, and a comparative table, showing the climate of New Zealand for the year, prepared, and the whole forwarded to the Registrar-General for publication with the statistics of the colony.

3. A monthly return is prepared for publication with "Vital Statistics," from information received by telegram from the six principal stations.

4. A return is also furnished to the press by the Wellington observer, giving the daily readings, with averages and remarks, for each month for that place.

5. A special yearly report is made on the climate of New Zealand, including results from all stations, as compared with previous years, for publication in the volume of Transactions of the New Zealand Institute.

6. A return, giving an abstract of the weather for the year, is also furnished for insertion in the yearly "Wellington Almanac."

7. Every two years a report is published in a pamphlet form, containing all the results of meteorological observations, and arranged in a convenient form for reference and comparison, together with all extra information from other than official sources on the subject, and giving diagrams and curves of the principal readings.

Time-Ball Observatory.

The astronomical observations required for giving mean time for the use of the Telegraph Department and throughout the colony are taken, as

hitherto, by the Ven. Archdeacon Stock; but the Observatory has lost a valuable amateur assistant through the death of Mr. John Kebbell, who for many years past devoted a great deal of his time and unrivalled mechanical skill to its interests.

A vote was obtained last session for the supply of a second rating clock and chronograph, and the necessary order has been sent to the Agent-General, with instructions to obtain it from the best maker in London.

The time-ball at Wellington is dropped by the Observatory clock, and the same time is supplied for dropping the time-ball at Lyttelton; but in neither case is the dropping-machine under the control of this department. It is very desirable that some uniform system of distributing correct time to the most important seaports should be organized, as inaccurate time-balls are apt to mislead ships' captains, who are accustomed to seaports in other countries where extreme importance is attached to the accuracy of the time-ball service.

Laboratory.

The number of analyses performed in the Colonial Laboratory during the past year is 235, which makes up the total number to 2401.

These are subdivided as follows, the same classification being used as heretofore:—

Coals and oils	12
Rocks and minerals	35
Metals and ores	52
Examinations for silver and gold	88
Waters	15
Miscellaneous	33

Certain special processes have been employed in different examinations which have been conducted during the past year, and a description of these will be found in the usual report, with the results obtained in the various samples to which they refer.

All analyses of interest or importance have been also reproduced in full, together with such notes as have been furnished to the contributors in reporting on the specimens submitted for examination.

Library.

Two hundred volumes have been added to the library since June, 1878. They consist chiefly of the publications of British and foreign scientific societies, received in exchange for the Transactions of the New Zealand Institute.

The whole of the books have been systematically arranged, and a catalogue made; but here, as in other parts of the Museum, the want of sufficient space leads to great inconvenience.

Accounts of the New Zealand Institute, 1878–79.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
Balance in hand 4th Sept., 1878	37	1	10	For extra copies of Vol. IX. ..	10	17	6
Vote for 1878-79	500	0	0	On account of printing Vol. XI.	477	0	0
Contribution from Wellington Philosophical Society (one-sixth annual revenue) ..	35	17	6	Miscellaneous items (including binding, woodcuts, &c.) ..	29	15	1
Received from Incorporated Societies under clause *d* of regulations of Institute, in aid of publishing Vol. XI...	78	2	6	Balance	140	16	3
Sale of volumes..	7	7	0				
	£658	8	10		£658	8	10

A. Stock,
Hon. Treasurer.

21st July, 1879.

APPENDIX.

On the Medical Aspects of Education.

By W. G. Kemp, L.R.C.P. London, M.R.C.S. England.

[*Read before the Wellington Philosophical Society, 23rd August and 13th September*, 1879.]

The subject that I have chosen to address you upon this evening is one of such immense importance, that I feel no apology is necessary from me in asking you to give me your attention, while I try and bring before you, as clearly and simply as I can, some points connected with it, that to my mind are not sufficiently considered by those who have the ordering of the education of children. I think I have not used too strong an expression when I say the subject is one of immense importance; for, if we consider that the boys and girls growing up around us are those who will ere long become the parents and educators of the generation succeeding them, we cannot over-estimate the importance of any means that will enable them more perfectly to carry out the duties that will be imposed upon them. In order that you may, at the outset, understand the line of argument that I intend to follow, I have set myself to answer the following question:—"Is the present system of education that best calculated to improve the physical as well as the mental condition of our children." I am of opinion that it is not, proofs of which I shall try to give you as I proceed. It seems to me that in the present day children are not so well off as animals, in the care given to their physical training; how much time and thought are bestowed upon the training of horses or dogs; what care is taken that they shall have their proper amount of exercise, proper quality and quantity of food! Is similar care paid to the food and exercise of children in order to keep *them* in good health? When they are sick they have as much or more care bestowed upon them, but surely it were wiser to have as much forethought for our children as for our animals, for without that forethought how can we expect to keep them in such a state of health as to fit them for the keen competition to which they must be subjected, and also to make them physically fit to bear the strain that will be put upon them.

The conventional usages of modern life, in ordering the education of children, have a tendency to push them forward without sufficient care being paid to physical training, the mere acquisition of knowledge being considered of more importance than the healthy growth and development of the bodily frame. The influences which increase the general health and strength, and produce strong muscles and sound limbs, are counteracted in their good effects by the undue pressure which is put upon the brain when it is least

able to bear it, and nature is thus thwarted, and her wise counsels defiantly ignored and set aside.

Dr. Clark says truly, "No perfect brain ever crowns an imperfectly developed body. When Michael Angelo reared St. Peter's dome, he made every stone contribute, not only to the use and beauty of the part he put it in, but to the support and power of the dome. The brain must be built up in connection with the building of the rest of the body, always bearing in mind that the imperfections of the latter have a direct influence upon the former."

The most common forms of disease in the present day are those which affect the nervous system, and we need not look far to find the causes which produce them. The strain to which the nervous system is subject, through the requirements of modern times, makes it far more liable to disease than formerly, and men break down prematurely from overwork and want of rest. Every branch of study is now pushed forward with an amount of vigour unknown to our ancestors, and men who wish to be admired and take a higher place than those around them, see no mode of gaining their end except by the acquisition of knowledge and the toilsome display of it.

Before civilization had arrived at the high state we now find it in, the overtaxed brain was confined to laborious students in the solitary contemplation of human knowledge. Nervous exhaustion was not the common disorder we now find it. In whatever direction a man now turns his attention, he is sure to see competitors who are striving after the same prizes. In trade, in commerce, and in art, it is ever the same—no man has the field to himself. Each one must strain every faculty towards the special object he is studying, and dare not leave his work for a moment for fear of being passed by. His thoughts are ever active and at work, and his brain will not rest, unless other occupations are found, and a new set of organs are called into play. Rest from thought would obviate much of the fatigue and exhaustion of the brain, if it could be adequately carried out, but the circumstances of life generally, do not enable a man to avail himself of that change of thought and occupation which would be a safeguard against the terrible evils he is fostering.

Diseases of the nervous system threaten to be the diseases of the future, as they are of the present day, in spite of any attempt to make it otherwise. Men, however desirous they may be to prevent it, are helplessly drawn into the contest, to struggle on and survive, or fall early and make way for others. If there is any truth in these statements, and I think you will grant that there is, is it surprising that the complex and highly organized structure of the brain and nerves should fail under this continued strain and struggle for existence in the battle of life? What wonder, then,

if the nervous system should suddenly or prematurely give way under the excessive strain put upon it. What wonder, then, that the nervous habits and excitable manner of the parents appear so frequently in the children, thus making them more liable to disease and premature death than others born under more favourable circumstances. Parents are greatly to blame in enforcing a course of study, or system of training, which is likely to induce disorders from which they suffer themselves. The likeness which a child bears to a parent, in outward form and feature, ought to teach us how transmissible is every taint and peculiarity, which it should be our constant desire to avoid and prevent. That such taints can be stamped out is a matter of daily experience, but it can only be done by placing the child under the most favourable circumstances, and watching over him with the most assiduous care, until the health is so thoroughly established that the taint or constitutional tendency to disease may be looked upon as being in complete abeyance.

As a natural outcome of these remarks, will arise the consideration of the question, Whether all children should be set the same tasks; or whether natural differences and temperaments should not be more carefully studied than they are at present? It is clearly the duty of parents to consider well these points, for they alone have the opportunity of studying the habits and dispositions of their children; and surely the cautious parent ought to consider the cheerful or mournful nature of his child—his mental as well as his physical strength—and be guided in his management accordingly. To take a boy who has an inherited tendency to consumption, or heart disease, or insanity, and to expect him to do as much hard work as another boy who has none of these tendencies, but is of perfectly healthy parentage, is obviously as opposed to common sense as it is to daily experience, and will probably tend to bring into activity the latent poison, to the premature destruction of mind and body. And when it is considered that, in all probability, the mental powers of the healthier boy are being taxed to the utmost, perhaps over-taxed, it is not difficult to see that the same amount of work imposed on those who are not absolutely healthy, makes it well-nigh impossible for physical and mental training to progress and flourish together. The quantity of work and the hours of labour ought to be carefully considered, according to the capacity of each child. What greater error could possibly be conceived than to enforce close attention to work when the brain feels a sense of weariness and the bodily strength is weak? The application is imperfect; the attention cannot be given for any length of time, because the vigour of the brain is failing and the intellectual functions are being spoiled. We must not, however, fall into a possible error by supposing that every child who learns easily and without labour is therefore healthy.

The aptitude and great desire for learning which children who are physically weak often show, is a matter of every-day experience; and, doubtless, most of you can call to mind cases of deformed and sickly children, in whom the mental powers are greatly in advance of their years. Such cases frequently come under the notice of the medical man, and it is often only by his timely interference that serious harm is averted, by the child being placed under influences suited to the proper maintenance and development of his physical system. When the child, at the age of from seven to ten,—unfortunately for itself—begins to show signs of undue quickness and power of learning, it is from this starting-point, I think, that mental training first begins to be at variance with physical health. Up to this time, perhaps, the child may have been living under influences which paid due regard to its bodily health—taking its proper amount of rest and play—until it is suddenly found out by the parent or teacher that there is mental soil that only requires careful attention and cultivation to make it, as they think, bring forth an abundant intellectual harvest! What is the process of cultivation that begins? The hours of work—which until now have been just enough to give the developing brain its necessary exercise—are increased; the child is stimulated to fresh mental efforts by being promised some taking prize or play, which are made to be a kind of set-off against work; the work itself probably is changed; from having been, up to this time, that in which the child took some degree of interest, it now becomes dull and uninteresting—perhaps the learning of Latin and Greek verbs (which, I need hardly say, has nothing to commend itself to the mind of a child of seven or eight years of age). The worst part of this training is, that the imposed work is actually done; and as the brain is very active because it is diverted from its natural course, the child it belongs to may become so unusually precocious as to be unnatural in its cleverness.

Dr. Richardson, an able advocate for physical training, when speaking of unusually clever, precocious children who are being pressed into learning, draws so faithful a picture of such a child that I will quote his own words:—"Let us look," he says, "at the inside of this marvellous picture, as a skilled eye can easily look, and understand too. These precocious, coached-up children are never well; their mental excitement keeps up a flush, which, like the excitement caused by strong drink in older children, seems like health, but is not. If you look at the tongues of these children you see them to be furred, or covered with many red points like a strawberry, or to be too red and very dry. If you inquire into the state of the appetite, you find that it is capricious, that all kinds of strange foods are asked for, and that the stomach is constantly out of order. If you watch the face for long, you will find that the frequent flush gives way to an un-

earthly paleness. If you watch the eyes, you will observe that they gleam with light at one time, and are heavy and dull at another, while they are never laughing eyes. Their brightness is that of thought and strain, a passing and dangerous phenomenon. If you inquire into the way in which these children sleep, you will hear that it is disturbed, and oftentimes broken. In a healthy child sleep comes on at an early hour, and when the eyes are closed and the body composed, it is continued till waking-time in a calm, peaceful manner, often without a change, even in position. You ask the healthy child about his sleep, he says he is simply conscious of having closed his eyes, and opened them again. But these unhealthy, over-taught children have no such joy. They sleep, perchance, to dream during half the night, and to be assailed with all the horrors and pressures of dreams; not unfrequently they become somnambulists. The bad sleep naturally leads to a certain amount of languor and tiredness the next day; but, strangely enough, it interferes with the natural advent of sleep the next night, so that sleeplessness becomes a habit. Now it is that stories must be told to the child, and thus it falls into slumber fed with the food of dreams, cares, and frights."

This picture may seem to you overdrawn; unfortunately it is not; indeed, more might with perfect truth be added to it, as daily observation proves. While on the subject of sleep, let me say a few words. The old saying, that "Six hours sleep is enough for a man, seven for a woman, and eight for a fool," is to my mind a great fallacy. I believe that a healthy person of from 30–40 years old should take not less than eight hours sleep out of the twenty-four; and children from ten to twelve, according to their ages. A grown-up person, whose brain is active during the day, requires at least eight hours rest, in order to make good what has been lost, and fit it to undertake its work on the following day. With a child, who has not only to make up the loss, but also to add to the size of its brain and whole body, much more is necessary; and unless sleep is taken in sufficient quantity the physical health as well as the mental energy must suffer. A child with any such unnatural aptitude for learning should be carefully watched, and when any signs of brain-fatigue begin to show themselves, all books should be at once put aside, and the child placed under the most favourable circumstances for improving the physical health.

Hitherto, I have spoken chiefly of the effects of modern school-life and training upon the mental and physical health of children predisposed to disease, owing to some taint transmitted to them by their parents. I now turn for a few moments to the consideration of the effect they have upon children who are of healthy parentage, and who are themselves in good health. Is it too much to say, that the present generation are on the whole

more liable to disease than the past? How do we explain the fact that diseases of the brain and nervous system are more common now than formerly?

It may be argued that the men of the present day are taller and larger than those who lived before us (as is proved by the small armour generally in use amongst the ancients); but this increase in mere size does not necessarily imply increase in health; indeed, when we consider the kind of lives the past generations have lived, giving way to excesses of every kind, and not suffering to any extent from them, we may, I think, fairly infer that their physical qualities were greater than ours now-a-days. We may then ask ourselves the question: How is it that we, who live under such improved sanitary influences, including in the word sanitary, food, clothing and ventilation—how is it, I say, that we are incapable of the same amount of physical strain as our ancestors, who lived in defiance of the laws of health? I believe there are several causes for this: First, our ancestors were obliged to breathe a purer air than we do, because they had not the same means of keeping it out as we have. They lived in houses less airtight than ours, having doors and windows which only partially served their purpose, for the latter instead of being glazed were merely closed at night with a shutter.

But I think that the chief cause of the decrease in physical power in the present day, is owing to the excessive mental strain put upon growing boys and girls. In this day the cultivation of the mental faculties is made to hold the first place in education. There are some, doubtless, who still maintain the superiority of physical over mental culture; but, generally speaking, the favour once exclusively tendered to purely physical training, is all but gone. Physical strength may, if it show itself in some singular manner, create a sensation for a time, but the excitement ends in the silence that follows clamour. Is it incompatible that physical and mental training should go hand in hand? I maintain it is not only compatible, but necessary for the proper cultivation of either. I think that if our attention be entirely devoted to one, to the comparative exclusion of the other, we shall not arrive at the same pitch of perfection, even in the one cultivated, as we shall by an equal cultivation of both. As a general rule, you will find at school and college, that the men who take the most active part in all athletic sports, are those who pass the best examinations, and pass with a less amount of work, and infinitely less injury to themselves. As a notable instance of the successful combination of physical and mental qualities, I may mention the late Bishop Selwyn. While at Cambridge he took a prominent part in athletic sports, and excelled in them, being for some years stroke of the University Eight; of his mental powers I need not

speak—his work in New Zealand will last after those who now see it have passed away, and I suppose there are few who will not own, that he was physically and mentally one of the greatest men New Zealand has ever seen.

The brain, like every other organ of the body, requires exercise in order to keep it in a state of health, and to assist it in growth. "In nature's order, the nervous system of an individual is the last to arrive at full development, and, of the nervous system, the brain arrives at full maturity later than any other part. Without exercise, an organ will attain little or no development; excessive or premature exercise will abnormally develope it, in either case to the injury of the rest of the organism." This being so, we must see then how great must be the injury inflicted on children and growing lads by undue mental pressure. More or less constitutional disturbance will surely follow an exertion of brain beyond the normal amount; and when the exertion is not sufficient to cause absolute illness, as would be the case in children pre-disposed to disease, it is sure to lay the seeds of impaired physical health, which sooner or later ends in confirmed nervous disease. The due performance of every vital act depends upon an adequate supply of good blood. If this be impure no part can properly perform its functions, for it has not brought to it the elements by which it grows, and healthy growth is essential to healthy action. This leads me to make a few remarks upon the subject of competitive examinations.

It is generally granted that those who cram, as it is called, for these examinations, do not learn as much as those who devote less time to their studies. I do not say that the former do not know more facts—certainly they do, but, whereas the less hard-working student keeps the greater part of his learning, the other probably forgets a great deal more in proportion, as soon as the examination is over. The mind, like the body, cannot assimilate more than a certain quantity of food; and if you force in facts faster than the mind can assimilate them, they are soon thrown out again; instead of being incorporated with the general fund of knowledge, they fall out again as soon as it is no longer necessary to keep them. Has it ever struck you that, in higher examinations, the student has to put forth his mental strength against an examiner who is generally an expert at his own subject, who could not perhaps compete with his pupil on the other subjects of the examination? and yet the unfortunate student has to face an expert in every subject, and be able to hold his own against them all for fear of failure. This, I need hardly say, implies unceasing toil for a long time before, toil carried on day after day, without sufficient time being given to recreation; ending often in a break down before the examination takes place, or, if the health lasts until the ordeal is over, the collapse comes afterward. Many, of course,

have gone through these high examinations without suffering from them; many more will continue to do it; but the fact that so many are injured and made unfit for active mental work by these means surely proves that there is something in them which asks more from its candidates than it ought to ask. Even were the system good in producing mental efficiency, which it is not, it would still be bad, because it prevents that physical training needful to make learning useful in life. Those who, in eagerness to cultivate their pupils' minds are forgetful of their bodies, do not remember that success in the world depends more upon energy than information; and that a system which, in cramming in information, undermines health and energy, is self-defeating. Strong determination, and untiring activity due to perfect health, when joined with that adequate education which may be obtained without sacrificing health, ensure an easy victory over competitors enfeebled by excessive study.

Dr. Richardson says, in speaking of competitive examinations:—"You have but to go to a prize distribution to see, in the worn and pale and languid faces of the successful, the effect of the system. And when you have seen them you have not seen a tithe of the evil. You have not seen the anxious young-old boys and girls at the time of the competition, or immediately after it; or between the time of the examination and the posting-up of the lists. You have not seen the injury inflicted by the news of success to those who have won, and by the news of failure to others who have lost. If you could, as through a transparent body, have seen all the changes going on; if you could only have seen one set of phenomena alone—the violent over-action of the beating hearts and the succeeding depression—you would have seen enough to tell you how mad a system you have been following, and how much the dull and stupid scholars are to be envied by the side of the clever, and, for the moment, the applauded, and flattered, and triumphant."

Mr. Herbert Spencer says, in speaking of the evils attendant upon the system of cramming children:—"Nature is a strict accountant; and if you demand of her in one direction more than she is prepared to lay out, she balances the account by making a deduction elsewhere. If you will let her follow her own course, taking care to supply, in proper quantities and kinds, the elements of bodily and mental growth necessary at each age, she will eventually produce an individual more or less evenly developed. If, however, you insist on premature or undue growth of any one part, she will, with more or less protest, concede the point; but, that she may do your extra work, she must leave some of her more important work undone."

A familiar proof of this statement is seen in the case of children who have outgrown their strength. We know that such children are wanting in

energy, both mental and physical; there is such a demand made upon nature to supply sufficient blood for the growth of the body, that she cannot at once do it, and so, the supply of blood being less than the demand, as a necessary consequence follows more or less impaired health in proportion to the demands put upon the natural resources of the individual.

These injurious abstractions of energy take place as certainly when the undue demands are slight and constant, as when they are great and sudden. Hence, if, during youth, the expenditure in mental labour exceeds that which nature has provided for, the expenditure for other purposes falls below what it should have been, and evils of some kind are surely entailed. The abnormal advance of any organ in structure involves premature arrest of its growth—(I mean by structure, increase in quality; by growth, increase in size). The brain, which during early years is comparatively large in size but imperfect in structure, will, if required to perform its functions with undue activity, undergo a structural advance greater than is appropriate to its age; but the ultimate effect will be a falling short of the size and power that would else have been attained. When the brain becomes altered in structure, we have, as a necessary consequence, imperfect nutrition or growth of the whole body. For perfect nutrition there are certain conditions absolutely necessary:—

1. A proper state and composition of the blood, from which materials for nutrition are derived.
2. A constant supply of such blood to every part.
3. The healthy influence of the nervous system.
4. A natural state of the part to be nourished.

Of the first two and last, I do not purpose to say anything, though it might be shown how they are affected by impaired nervous influence. I only purpose saying a word or two upon the influence of an unhealthy nervous system upon nutrition. I have endeavoured to show you that premature or excessive demands put upon the brain, cause it to undergo alterations in structure; this unfits it for the healthy performance of its functions; the processes of circulation, respiration, secretion, assimilation of food, etc., are all under the direct influence of the brain and nervous system, and as this is not in a state of perfect health, it follows as a logical sequence that they cannot be carried on as they ought to be;—to the injury of the whole constitution.

We might, I think, with advantage, copy somewhat the educational system of the ancient Greeks and Romans, barbarians though we are wont to call them. Amongst the former, education was divided into two parts: music and the gymnasium, or mental and physical training; that is, they made physical as well as intellectual training, a science, as well as a study.

Their women practised those out-door exercises which were calculated to develope the physical frame, such as ball, often accompanied by dancing and singing; proof of this is to be found in Homer. It is probably by such attention being paid to physical strength, that they earned for themselves the name of being the most beautiful race the world ever saw; side by side with this training went mental culture, in which they excelled, being perhaps amongst the cleverest of people.

It may, perhaps, have occurred to some of you, that I ought to lay before you some ideal scheme by which all the dangers I have mentioned might be averted. I have no such intention; my object has been simply to show some points upon which the present system of teaching is at variance with the laws of health, for that is the part which comes more immediately under my notice in my daily work.

I am of opinion that unless some alteration be made in the amount, and ever increasing amount, of work expected of boys and girls in our higher schools, in the next generation those who will take the highest places in the intellectual world will be those who come from our National Board Schools, where less is asked of them, and where they are taught sufficient to give them an interest in their work, and are taught how to do their work, and to carry it on after they have passed the usual age for being at school. In these schools there is not the high standard of the Universities, doubtless there is competition, but it is not of that severe kind we find in higher examinations, and so the pupils, while doing a fair amount of work, have not their time so completely taken up by study that they have none for the physical exercises necessary to keep them in health.

Since this paper was written I am glad to hear that in some of the large public schools at home—Harrow, I am particularly alluding to—it is made compulsory upon all the boys that they shall take some part in the school sports. This, I think, is a wise step, and, if systematically carried out, will tend in time to avert many of the dangers I have been speaking of.

I believe many of these dangers might be prevented if parents and teachers had some knowledge of those physiological laws which are concerned in the preservation of health. How frequently it happens that after a young lady leaves school she employs her time in fancy work, singing, drawing, and such occupations; she next becomes a parent, and without any knowledge of the training of children is obliged to look after one of her own; she is frequently uncertain what to do, and now it is that she seeks the advice of ignorant nurses, with what result I need not say. What should we think of a merchant commencing business without a knowledge of book-keeping; we should certainly look for failure; but parents frequently begin the task of bringing up their children without ever having thought of

the principles that should guide them, and how frequently is failure the issue.

I had intended, had time allowed, to have spoken of the influence of school life upon the sight and figures of children, showing how they are injured from ignorance of the proper size and position of seats, desks, and windows. I must, however, pass them over in silence, though it ought to be carefully considered in all schools, as the seeds of short sight and curvatures of the spine are almost always, I might say always, laid at school.

In conclusion I wish to guard myself against the charge of undervaluing education and mental training ; I value it in the highest degree ; all I wish to insist on is that it shall be carried on *pari passu* with physical training, and that the peculiar tendencies possessed by individual children shall be more carefully studied, and the amount of work given to those children ordered accordingly.

The last time I had the honour of addressing you in this room on the subject of the education of children, I tried to point out to you some of the evils which are attendant upon the present system of school training—how it fails to make any allowance for differences of temperament and disposition in children ; what little chances a boy or girl, who has an inherited tendency to nervous disease, insanity, consumption, or heart disease, has, under present existing school life, to outgrow such tendencies ; indeed, there is almost the certainty of developing them into activity ; how, during school life, so little attention is paid to physical training, the great aim being to develope the mental powers to the utmost, at the expense even of physical health ; how the high competitive examinations of advanced schools and colleges are fraught with infinite danger to those who engage in them, because they demand more of their pupils than they can be expected to give, without at the same time injuring their brains and nervous systems ; and how much more strain and demand is put upon the mental powers of growing children than ought to be put upon them. I purpose this evening to pursue the subject further, and endeavour to show you when pressure may with safety be put upon children, and also to show how sight and figure are injured, from ignorance of those laws which should be observed in order to preserve school children from affections of the eyes and spine.

The first question, then, that presents itself for our consideration is, When may we with safety put pressure upon a child ? It is obvious that no answer can be given to this question, which shall be of universal application ; for so many circumstances have to be considered, that each case must be carefully studied and our answer framed accordingly. We all know that probably no two children are exactly alike in temperament, habits, power

of learning, etc., and so work that will prove a healthy stimulus to one, will exhaust and over-tax the other. If a child has had his intellect carefully and slowly unfolded, he will be in a very different position at six or seven years of age to one whose mental faculties have been uncultivated up to that time; the memory may be exercized with safety, and the gift of imitation, so strong in childhood, made use of from an early age. The mind, like the body, is amenable to proper management, and when this is gradual, and not premature or forced, the power of learning will be made easy in proportion. The process of pressure must be carried on with a full appreciation of what the child can do with pleasure, and must not cause weariness, our object being to make the acquirement of knowledge pleasureable rather than painful. We may generally take it for granted that the rise of an appetite for any kind of information implies that the unfolding mind has become fit to assimilate it, and needs it for purposes of growth; and that, on the other hand, the disgust felt towards such information is a sign either that it is prematurely presented, or that it is presented in an unwholesome form.

In this, as in all systems, the more we can find out and follow nature's plan of working the more likely are we to be successful. We should endeavour to conform education to the natural process of mental evolution, for there is undoubtedly a certain sequence in which the faculties spontaneously develope, and a certain kind of knowledge which each requires during its development; and it should be our constant endeavour to ascertain this sequence, and supply the knowledge necessary for each period. It has been truly said, "The method of nature is the archetype of all methods:" and if this be studied and carried into practice in putting pressure upon children, we may before long find that subjects which a short time ago were distasteful are now becoming pleasant, or, if not actually pleasant, yet undertaken with much more cheerfulness than they would have been had we pressed them upon a child, at a time when nature seemed to cry out against them. A time, of course, comes when uninteresting work must be faced and done, and by no means can we make it otherwise than uninteresting. Now it is that great care is necessary. We must try and measure carefully the child's power to support the strain of forced attention; the time spent in this uninteresting work should not be long without allowing either a certain amount of rest or change of occupation; for if it is continued after the child gets weary of it, no more will be learned, and, if this continues for any length of time, the health of the child will suffer and his mental powers become impaired.

Dr. Richardson, in speaking of education at this period, says:— "Another error consists in failing to allow for difference of mental

capacity and turn of mind in different learners. There are many minds of neutral tendency—minds that can take in a certain limited amount of knowledge on almost any and every subject, but which can never master much in anything. These minds, if they be not unduly pressed or flattened down, become in time moderate in learning, and sometimes imbued with the plainest common sense. They bear at school much work with comparatively small injury, for they are known to be dull, and great things are not expected of them nor attempted by them. They do the necessary work of mediocrity—in this world a most important work. There are two other very different orders of minds. There is the mind analytical—that looks into details in business, into elements in science, into figures and facts in civil and natural history. In the school such a mind is good at mathematics—good at facts and dates, good at niceties of language. In these directions its lessons are pleasures, or, at most, scarcely labours. There is, again, the mind constructive or synthetic—the mind which builds; which uses facts and figures only, in the end for its own purposes of work; which easily learns principles of construction; which grasps poetry and the hidden meaning of the poet; which is wonderful in its power of keeping knowledge as a whole, and which cannot take fast hold of minute distinctions. In the small school of the youth, as in the great school of the world, these two orders of minds are ever present. The mistake is, that they are so commonly confounded, and that no change is made in the mode of study to suit the genius of the one or the other. The consequence is, that lessons are given to these two classes of minds which neither can master. Under these conditions, both chafe and get weary, and still do not get on. Then they fall into bad health, grow fretful and feverish, are punished, and otherwise made unhappy and morose. And so, if they be unduly forced, they grow up unhealthy in body and mind, feeling that the occupations into which they have drifted are uncongenial to them, for they know that they have not mental power necessary to carry them on successfully."

Without going at any length into the order of the gradual expansion and invigoration of the mental powers, I cannot pass the subject by without giving a word of warning, especially to parents. The formation of associations takes place with great ease and rapidity during the earliest period of childhood; and these exercise so much influence over the succession of the thoughts and the disposition of a child during the whole remainder of life, that the "force of early associations" has become proverbial. It may be granted that the state of feeling which is habitual to each individual may depend in great measure upon his peculiar constitution, yet it is unquestionable, that his disposition, thoughts, and feelings, are largely influenced

by sympathy with the like states in those among whom the child receives his early education. It is of the utmost importance, therefore, that the companions of young children should be such as it is wholesome for them to imitate; since it is upon the habits of feeling thus early formed that the happiness and right conduct of after-life mainly depend. We must carefully watch and understand the disposition of our children, so as to suit their surroundings to their peculiar wants. To allow a child who is perhaps dull, and of what is known as a phlegmatic nature, to associate constantly with another child similarly constituted, or with one who is in any way deficient in mental power, would be to risk the healthier child, and probably cause him to grow up dull and sullen; our object should be to choose companions for him quick and bright, and with as much animal life in them as possible, so that the heavier child may from association catch some of their brighter ways, and gradually grow into more cheerful thoughts and habits. It may perhaps be urged in answer to this statement, that, as a general rule, the activity with which the formation of new ideas takes place in a child, and the quickness with which the attention transfers itself from one object to another, prevents any single state from fixing itself, in anything like a permanent manner, in the mind, so that memory preserves but faint traces of the greater part of what passes through the mind; this is undoubtedly true, but it must be remembered, that although individual impressions are more speedily dissipated from the minds of children, than from those of adults, yet that when impressions of the same kind are frequently repeated, the brain grows into them in such a way that they become part of it, and take part in its ordinary working; and thus by establishing a particular mode of nutritive assimilation, they tend to perpetuate this acquired habit, of whatever nature it be. As there is constant change going on in the body, old particles giving place to new ones, and these again to others, it may be thought that the diseased particles would in time die out, and give place to new healthy ones. This is not the case, for each atom of the body imparts to the atom that takes its place its own structure in every way, so that marks, as scars and moles, never die out, but last as long as the person possessing them lives.

A writer on diseases of childhood says, "Looking at the physical health of a child, as a means of judging of its mental strength, I think the commencement of the second dentition is the earliest period when instruction requiring brain-work can be safely pushed. Even then the knowledge should be of a kind which accords with the evolution of the different faculties, or the mind will become disgusted with the difficulties placed before it, and not having mastered simple subjects it will be unfit to receive more complex ones; hence, precise methods of instruction, and exact defi-

nitions, if attempted too soon, will be fraught with evil, and the child will languish under the accumulation of facts with which its mind is weighted."

Most of you are probably aware that a child begins to cut its second teeth at seven or eight years of age, and finishes at about fourteen, (except the cutting of wisdom teeth), and as at this time there is often a re-appearance of any nervous symptoms that may have shown themselves when the first teeth were being cut, I fully concur with the statement I have just read, and think this period of second dentition one during which mental training should be proceeded with with the utmost caution, because at this time the physical growth is very active, and the animal functions are proceeding with extraordinary vigour, and a large amount of rest and sleep are necessary for the building up of the tissues. There is also, at this period of from seven to fourteen years of age, an extreme sensitiveness of the nervous system, and special liability to sympathetic disturbance, as well as a special tendency to the development of transmitted taints, which may be outgrown as years pass by. It is generally during this period that slight causes will produce St. Vitus' dance and epilepsy; indeed, sometimes they can be traced to no other cause than the cutting of a tooth. During this period also the organs of assimilation and digestion are very active, and derangements which are brought about by impaired nutrition are especially common. Any immoderate intellectual training at a time when these organs are enfeebled, and the appetite poor, may so impoverish the quality of the blood as to increase the sensitiveness of the brain and nervous centres and bring on actual disease. It has been proposed by Mr. Saunders in a paper called "The Teeth as a Test of Age," to adopt the successive stages in the cutting of the second teeth as standards for estimating the physical capabilities of children, especially in regard to those two periods which the factory laws consider it of the greatest importance to determine, namely, the ages of nine and thirteen years. Under nine a child is not allowed to work at all, and up to thirteen it may be only employed during nine hours a day; it has been found necessary, owing to the untrustworthy statements of parents, to seek for some test by which the capability of a child can be determined without knowing its age. A standard of height was first adopted, but this on physiological grounds is erroneous, as it is a well-known fact that the tallest children are by no means always the strongest; indeed, frequently the contrary is actually the case. According to Mr. Saunders, the degree of advance of the second dentition may be considered as a much more correct standard of general development of the organic frame and its physical powers, and it appears from his inquiries that it may be relied on as a guide to the true age and strength of children in a large proportion of cases.

It is a generally accepted fact, that the brain grows very fast up to seven years of age, it then attains an average weight in boys of 40 ounces. The increase is much slower between seven and fourteen, at which time it attains 45 ounces; still slower from fourteen to twenty, when it has attained its full size. Consequently of the more difficult intellectual exercises, some, that would be impossible at five or six, are easy at eight, through the fact of brain-growth alone. It often happens, and I think the experience of all teachers will bear me out in this: You try a pupil with a particular subject at a certain age, and you entirely fail; wait now a year or two, and you succeed, and that without seemingly having done anything expressly to lead up to the point; although there will undoubtedly have been, in the meantime, some sort of experience that prepares the mind for the reception of the more difficult subject. Another reason why it is all-important for us to find out and supply the proper quantity and quality of mental food to growing children is, that at this period of life the brain is in its most plastic form, and what it assimilates it does so thoroughly as to make it part of itself—not to be lost after a time, but to remain for ever as the good foundation upon which, in after years, to build a superstructure of intellectual knowledge. If, however, instead of supplying proper food, we try and force in what the brain cannot bear, we do double harm: first, by putting upon the brain a demand which it is incapable of bearing without injury; second, by depriving it of that healthy food by which it grows and becomes prepared ultimately to receive more advanced knowledge. The amount of harm done is greater in the former than in the latter case, for, as I tried to show in my last paper, undue pressure put upon a growing and developing brain, will have the effect, either of developing it abnormally in structure and at the same time prematurely arresting its growth, or of so overtaxing its powers that it will at once give way owing to some form of disease. In either case, if death does not ensue, it will be unfit to carry on its work, and so all those functions which are immediately under its control will be imperfectly performed, and physical ill-health will follow. If the true end and aim of education were kept more clearly in view, I think less harm would be done.

The object of education ought to be to open-out the undeveloped nature of a child; to bring out his faculties, and impart skill in the use of them; to set the seeds of many powers growing; to teach as large and varied a knowledge of human nature as possible; to give him, according to his circumstances, the largest practicable acquaintance with life, what it is composed of, morally, intellectually, and materially, and how to deal with it. The mere acquisition of knowledge is not education; a writer on this subject says: "A man may be able to count accurately every yard of dis-

tance to the stars, and yet be most imperfectly educated; he may be able to name all the kings that ever reigned, and yet be none the wiser, or the more efficient for his learning. But the unfledged boy, who starts with a mind empty and blank, is transformed by education. New ideas, new perceptions are awakened in him, that is, new fitnesses for life, for its labours and its duties."

Besides this, I think one of the ends of education should be to give children such an interest in work that they will continue to pursue it after their school-days are finished; I fear that, under existing circumstances, children, instead of being made fond of work and learning, are pretty sure to get to hate it; because, what ought to be the work of many years is now compressed into a few, and so the child gets to look upon his work as a weary labour, and his master as a kind of natural enemy, who imposes tasks for which the child has no real liking; and the probable result is, that as soon as school-days are over, the child puts away the work at which years have been spent, unless it has to be kept up in order to carry on his daily duties.

I suppose there are few who would question the statement, that the test applied to prove the efficiency of any school is, what place do the pupils from that school take in examinations? And yet this is a most unfair test, for examinations, especially competitive, are merely a proof of the extent to which the memory has been trained; natural genius cannot compete in this trial unless there is at the same time a good memory, and surely one is as deserving of praise as the other. The test of educational success is not solely or even chiefly the amount of positive knowledge which has been acquired; but the extent to which the faculties of the boy have been developed, and his general fitness for life and for his action in it as a man; —the object should be to produce as perfect a being mentally and physically as possible, and one who is in both senses fit to enter the arena of life. The want of the due cultivation of these two sides of a child tends greatly to impair vitality. On this point Dr. Richardson says:—"Next to alcoholic intemperance I should place as a cause of impaired vitality in our people the physical and mental strain to which the younger members of our communities are subjecting themselves that they may stand first in the ranks, and, at middle age, retire to wither in empty competency. This rage, amounting to insanity, is checked by nature at every step. Her offspring are not made for this end. To work moderately until the end of the cycle of life is the plan pre-arranged for us all; the condition under which we are born, that we may live until the cycle is perfected. If we break through this condition, if we destroy one organ only of the exquisitely balanced economy through which our vital faculties are construed into life, we simply die."

There is an important phase of this subject into which I cannot enter, but hope some one more competent will, namely: Whether the range of subjects taught in our schools is not too large, whether it is better to try and give children a general knowledge of a great many subjects, or a thorough knowledge of a few. I think the fault here, if any, lies not with teachers, but with parents; they are anxious that their children should have, as they call it, "every advantage," and so one subject after another is added to their studies, until the number is so great that efficiency in any of them is well nigh impossible. The effect, too, of the present school training upon teachers is a subject worthy of attention. Whether they are not overworked in common with their pupils; whether too great a demand is not made upon what should be their leisure time; whether their brains are not working at high pressure, and so injuring their fitness for their work—all these are points which I hope some one will take up and discuss, and show whether the present system is injurious or not.

It is certain that a fully-developed brain will stand much more work without harm than a growing one will; yet there are limits to its endurance; and I think it may with tolerable safety be stated that, so long as a brain-worker is able to sleep well, to eat well, and to take a fair proportion of outdoor exercise, it is not necessary to impose any special limits on the actual number of hours which he devotes to his labours; but when what is known as anxiety steps in to complicate matters—when cases connected with those numerous personal details from which we can seldom escape, intervene; or when the daily occupation of life is in itself a fertile source of anxiety—then we find one or other of these three safeguards broken down. Probably the anxieties of the day cannot be shaken off at night; sleep becomes fitful and disturbed; the sympathetic nervous system, unsettled by the mutual strain, brings about various defects in nutrition; the appetite fails, and the vigour of the nervous tissues is no longer able to withstand the endless work put upon it; then we meet with sleeplessness, dyspepsia, uncertainty of action, and the depression which are among the chief miseries of those whom we call overworked.

I now pass on to the consideration of the effect of school-life upon sight and figure. The most common affection of the eye caused by school-life is short-sightedness. In order to explain what is the condition causing it, I refer you to this diagram:—Short-sightedness is developed almost always during school-life; rarely afterwards, though sometimes from the same causes which produce it at school. This is an acknowledged fact, proved by the experience of all who have much to do with eye-diseases. A question naturally arises, Are children at the time when they are old enough to go to school more liable to short-sightedness than they are before or after that

time? or, Has school-life caused the short-sightedness? Statistical inquiries prove the latter to be the case, and have shown at the same time that the percentage of short-sighted children is greater in schools where unfavourable optical conditions prevail. Dr. Colm, a German oculist, examined the eyes of 10,000 school-children, and could distinctly trace the increase in the proportion of short-sightedness according to the construction of the desks and lighting of school-rooms.

It is true that short-sightedness is often inherited, but this must not be thought to mean that the children of short-sighted parents are always born short-sighted. They have only the pre-disposition to become so, and this pre-disposition is developed during school life more or less, according to certain external conditions; and the more so, of course, under conditions which tend to produce short-sightedness even in children who have no inherited pre-disposition. There is an idea prevalent in the minds of most people that short-sighted eyes are particularly strong, and last longer than other eyes; unfortunately this is not the case, a short-sighted eye must always be looked upon as being unsound; the reason why they are considered to be so lasting is that they can see near objects distinctly at an age when the normal eye requires glasses; and also that owing to natural changes which take place in the eye as age advances, the range of vision increases; but under all circumstances a short-sighted eye must be looked upon as an organ requiring special care, and to be placed under the most favourable circumstances in order to keep it from getting worse. Short-sightedness has an injurious influence on the health by inducing a habit of stooping; and the very habit which it induces reacts again upon the sight and tends to make it worse. There can be no doubt that the degree of short-sightedness is often greatly increased during childhood by long-continued study, more especially by insufficient illumination, and a faulty construction of the tables or desks at which the pupils read and write. An insufficient illumination necessitates a close approximation of the object to be seen, which gives rise to straining of the accommodation, and congestion of the eyes. A faulty construction of the tables, or of the latter and the seats, is also injurious by forcing the children to stoop. This continued straining of the eyes is of itself sufficient to bring on short-sightedness in eyes perfectly healthy, provided it is kept up for a long enough time. The near approach of the object necessitates a strong convergence of the visual lines, which causes an accumulation of blood in, and congestion of the inner coats of, the eyeball, and if this lasts for any length of time, more or less thinning of the coats takes place, which is the first step in the production of short sight.

Have we no means at our disposal for preventing these evils? There is no doubt that a great deal can be done by the proper construction of

school-rooms, and proper position of seats and desks, but even this will not suffice, unless those who have the care of boys and girls know something of the physiological reasons why they are so constructed, and are fully alive to the dangers which they are trying to avert from their pupils. It may be said I am raising a cry without any cause. I do not admit this without proof, and none can be given until the children who attend our schools are carefully examined, and I would venture an opinion that 10 per cent. would be found suffering from defect of sight. Is there any position from which light should come so as to produce no harm to the eye? First, it should be sufficiently strong to produce a good illumination, even of small print; it should as far as possible come from above the level of the heads of the pupils, and from the left side. Light coming from the right-hand side is not so good as that coming from the left, because the shadow of the hand falls upon that part of the paper at which we are looking; if it come from a high window it is allowable, but the left side light is decidedly preferable. Light from behind is bad, because a shadow is thrown upon the book by the head. Light coming from the front, and falling upon the faces of the scholars, is perhaps worst of all, because the strong glare is both unpleasant and injurious to the eye, fatiguing it by the full glare thrown upon it, and making the images at which it is looking more difficult to be seen; and it is always found that children instinctively run away from such a light, showing the annoyance they feel from it.

The same rules should, as far as possible, be observed in lighting school-rooms during the evening. An eminent German oculist, who has carefully investigated the subject, says:—"It is difficult to arrange gas-light well, but easy to arrange it better than has been done in most schools. Almost everywhere I have found naked gas-jets, which give an unsteady, bad light. Glass cylinders would make the flame whiter and steadier. Ground-glass globes ought not to be used; they are useful for the ordinary lighting of a room, as they diffuse the light more equally throughout all parts; but for that very reason they give an indistinct light for work, and, if they are opposite to the eye, are dazzling and injurious. This property of diffusing light makes ground glass useful for lighting up the darker parts of a room by daylight also, where there is no direct light from the window; but care must be taken that it is only used for the upper parts of windows, or for sky-lights."

During the past fortnight I have visited most of the Public Schools in the city, with a view of ascertaining upon what system they are lighted, and I must say the result of my investigation has been on the whole unsatisfactory. There is no attempt at putting the windows and desks in suitable positions, and in some cases the light is insufficient as well as impro-

perly placed. I understand that, in building schools, the Education Board has no system or general plan of lighting, the position of the windows being left to the fancy of the architect, who, probably ignorant of the subject, puts them in where he thinks they will look best, and of such shape as will add most to the architectural effect of the building. In some of the class-rooms I have visited, the children who sit in the corners of the room are in such a dim light that there must of necessity be a continual strain upon their eyes, which cannot fail in time to produce defective sight. The most common plan of lighting the class-rooms seems to be, to have a window at one end of the room and two or more along one side; the seats are then placed so that the children either have their backs to the side where the windows are, or their faces; in both cases the effect is bad, because, as I have before said, light from behind throws a shade upon the desks, and light from in front is exceedingly bad by causing great fatigue to the eyes, owing to the constant glare they are exposed to. In one school where the children face the windows, I was told by the teacher that when the black-board is used on bright days the children complain they cannot see what is written upon it owing to the brightness of the light; and so the windows are darkened with thick green blinds, which make the end of the room opposite the windows too dark to allow of one clearly distinguishing anything. I need hardly say that children in this school are subjected to constant straining of the eyes—in one case from too much, in the other from too little light, the effect of both conditions being to overtax the sight and develope any latent tendency to short-sight that may exist, or lay the seeds of it in those otherwise healthy. In other schools, the upper part of the windows, which is by far the most important part, is darkened, because it would not be in keeping with the rest of the building to have them square and with large panes. Here the admission of sufficient light is clearly sacrificed to architectural taste.

I now pass on to make a few remarks upon the form of seats and desks. The chief faults under this head appear to me to be—

1. Want of backs to the seats.
2. Too great distance between the seat and desk.
3. Want of difference of height of the seat and desk for different sized children.
4. Want of means for altering the slope of the desk for reading and writing.

If there is no back to the seat, and the child is sitting for an hour or two at a time, it stands to reason that the muscles which keep the spine straight must become tired, and so fail to keep the body upright; it then stoops, and the child feeling a sense of weariness puts itself into some un-

natural position, in order to put the strain upon some other part of its body; it either sits upon the back edge of the seat and rests its chest against the edge of the desk, or throws the weight of the head and shoulders upon the arm put between the body and the edge of the desk, both of them unhealthy positions, as they compress the lungs and prevent their free action, besides forming more or less of an angle in the back. If the child has to read a book placed on a desk at too great a distance, it sits on the edge of the seat, and soon becomes tired, when what I have just described is sure to happen; or the child will rest its chin upon its hands, and thus tend to elevate its shoulders in an unnatural manner. In no school in the city have I found backs to the seats; and the distance between the seat and the desk varies in different schools. In most, it is, I think, too great, certainly to allow the child to be comfortable while writing. The distance being so great, the child must of necessity sit upon the very edge of the form, a most tiring position; or if it sits upon the seat so that half the length of the thigh is supported by the seat, it must lean forward so as to make with its back an angle of about 45°. These defects could be overcome by having the seat broad enough to support at least two-thirds of the thigh, and the height of the seat such as to allow the sole of the foot to rest comfortably on the ground; the edge of the desk should be above and perpendicular to the front edge of the seat, and just high enough to allow the elbow to rest upon it without pushing up the shoulder. The angle at which the desk should be is also an important point. Dr. Liebreich, who has written upon this subject, says, that to ensure as much ease as possible to the eye, they should have an inclination for reading of about 40°, for writing 20°. In order to answer both these requirements, he has suggested a desk, which, by a very simple contrivance, gives the desired position for reading and writing.

The ordinary kind of back generally put on to forms is not that which should be copied for school seats. It is usually too high, catching the person seated across the shoulders, and leaving the lower part of the back and spine unsupported. In weak persons the tendency is to bow the back outward, because the ligaments and muscles of the lower part of the spine get tired, and can no longer support the body. The proper kind of back for school seats is a strong, not very wide, piece of wood projecting straight up, or if inclined, with only a slight inclination backward; the height must vary somewhat according to the length of back of the child, it being necessary to support the lower third of the back, or up to the level of the waist. In some parts of America so much importance is attached to the subject of desks, seats, and backs, that every child has its own made for it, unless there are any perfectly suited to its height in the school to which it is sent.

In Switzerland, there are seven or eight different sizes made to suit the different classes. The London School Board has adopted the following suggestions for its schools :—

1. One and the same size and model of desk should be used for children of both sexes.
2. The adaptation to the height of each child should be effected by varying the height of the seat and foot-board.
3. The edge of the table is always to be perpendicular to that of the seat.
4. No seat is to be without a back, and the top of this is always to be 1 inch lower than the edge of the table for boys, and 1 inch higher than the edge of the table for girls.

    In schools where, on the score of expense, each child cannot have a separate desk, four may be made to occupy one seat, and, to allow the two centre ones to get out without disturbing their neighbours, it is only necessary to intercept the back rail in the middle—leaving sufficient space for a child to pass out and in.

    A child should sit with the upper part of its body straight, the vertebral column neither twisted to the right or left, the shoulder-blades of the same height, these and the arms freely suspended on the ribs, and in no way supporting the body; the elbows on a level with each other; the hands and part of the forearm resting on the desk; the weight of the head freely balanced on the vertebral column, not bent forward, but only turned sufficiently to prevent straining of the eyes in looking at a book placed on its desk.

In concluding these remarks, I must assure you that they are the conclusions I have arrived at after having given the subject considerable attention. I have had many of these points in my mind for some time past, but until now have lacked the courage to formulate them and make them known. I feel deeply the importance of the subject I am advocating, and hope what I have said may bring forth some practical fruit in making parents and teachers more alive to the fact that there are dangers, and great ones too, from which they ought to protect their children and pupils, and to remind you that all who in the face of custom or prejudice insist upon their children being placed under the most favourable circumstances for making them physically and mentally healthy, and fit to enter the struggle of life, are doing a lasting good, not only to the children themselves, but also to future generations, for it is only by producing strong and healthy children that we can produce strong and healthy men and women. If the time ever arrives, and I fear it is fast approaching, when girls and women will be subjected to

the same intense mental strain that boys and men are now subjected to, owing to our much-lauded civilization, then one of the great safeguards to our national health will be gone ; hitherto the female portion of the population has had at least a chance of escaping work and labour from which the male portion could not escape ; but now they cry out against being debarred from those pursuits which are open to men, and are striving to compete with him in his arduous professional tasks, instead of being thankful that their lot has been cast in less stony places, and that they are not, as a sex, obliged to earn their livelihood at the expense of excessive brain-work, impaired health, and often premature death.

NOTE.—I have, here and there in these papers, used the words of well-known writers upon this subject without, in each case, quoting as a distinct reference.

THE CLIMATE OF NEW ZEALAND.

METEOROLOGICAL STATISTICS.

The following Tables, etc., are published in anticipation of the Report of the Inspector of Meteorological Stations for 1879.

TABLE I.—TEMPERATURE OF THE AIR, in shade, recorded at the Chief Towns in the NORTH and SOUTH ISLANDS OF NEW ZEALAND, for the year 1879.

PLACE.	Mean Annual Temp.	Mean Temp. for (SPRING) Sept., Oct. Nov.	Mean Temp. for (SUMMER) Dec., Jan., Feb.	Mean Temp. for (AUTUMN) Mar., Apl. May.	Mean Temp. for (WINTER) June, July Aug.	Mean daily range of Temp. for year.	Extreme range of Temp. for year.
NORTH ISLAND.	Degrees.	Degrees.	Degrees.	Degrees.	Degrees.	Degrees.	Degrees.
Mongonui	61·6	61·2	68·1	62·6	54·3	17·1	50 0
Auckland	59·1	58·3	65·6	60·8	51·8	13·5	48·2
Taranaki	56·8	56·3	62·5	58·8	49·9	16·1	53·0
Napier	58·8	58·7	65·4	60·2	50·8	13·2	49·0
Wellington ..	55·1	55·1	60·7	57·2	47·4	12·2	48·1
Means, etc., for North Island	58·3	57·9	64·4	59·9	50·8	14·2	53·0
SOUTH ISLAND.							
Nelson	54·9	55·6	61·2	56·0	46·9	22·0	58·0
Cape Campbell ..	*57·0	55·1	61·9	58·9	†49·6	9·4	41·0
Christchurch ..	52·3	52·4	60·1	54·5	42·1	16·8	65·7
Hokitika	52·8	53·2	58·7	54·6	44·6	14·6	47·0
Dunedin	50·0	50·5	55·9	51·6	42·0	12·9	49·0
Queenstown ..	49·5	52·1	58·0	50·5	37·6	17·8	61·2
Southland	49·7	51·3	56·6	50·8	40·0	19·6	68·0
Means, etc., for South Island	52·3	52·9	58·9	53·8	43·2	16·1	68·0
Means, etc. for N'th and South Islands	55·3	55·4	61·6	56·8	47·0	15·1	68·0

* For 11 Months only. † For June and August only.

TABLE II.—Barometrical Observations.—Rainfall, etc., recorded for the year 1879.

Place.	Mean Barometer reading for year.	Range of Barometer for year.	Mean Elastic Force of Vapour for year.	Mean Degree of Moisture for year.	Total Rainfall.	Mean Amount of Cloud.
North Island.	Inches.	Inches.	Inches.	Sat.=100.	Inches.	0 to 10.
Mongonui ..	29·993	1·648	·427	77	58·920	6·4
Auckland ..	29·990	1·546	·385	76	46·130	6·3
Taranaki ..	29·964	1·470	·362	77	60·180	5·9
Napier ..	29·964	1·551	·361	72	53·140	3·1
Wellington ..	29·961	1·545	·356	81	57·441	5·2
Means for North Island	29·974	1·552	·378	76	55·162	5·3
South Island.						
Nelson	29·909	1·441	·340	78	61·420	5·2
Cape Campbell*	30·058	1·460	·347	75	23·990	6·6
Christchurch ..	29·936	1·803	·279	71	23·180	6·4
Hokitika ..	29·935	1·691	·336	83	128·295	5·5
Dunedin ..	29·871	1·895	·277	76	42·099	6·4
Queenstown ..	29·843	1·700	·240	67	22·420	5·6
Southland ..	29·850	1·910	·278	77	33·260	6·6
Means for South Island	29·914	1·700	·299	75	47·809	6·0
Means for North & South Islands	29·944	1·626	·338	75	51·485	5·6

* For 11 months only.

TABLE III.—Wind for 1879.—Force and Direction.

Place.	Average Daily Velocity in Miles.	Number of Days it blew from each Point.								
		N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm*
North Island.										
Mongonui ..	180	23	66	46	13	16	56	35	56	54
Auckland ..	280	35	72	33	21	50	69	51	34	0
Taranaki ..	215	21	55	39	98	10	70	29	43	0
Napier ..	196	16	97	18	27	67	61	28	29	22
Wellington ..	205	1	37	4	133	0	8	1	179	2
South Island.										
Nelson ..	138	47	93	23	77	17	77	2	29	0
C. Campbell †	425	17	6	3	146	14	0	1	144	3
Christchurch	142	3	94	70	17	5	144	11	21	0
Bealey ..	—	57	30	10	50	2	12	8	129	67
Hokitika ..	—	5	56	67	17	4	129	32	55	0
Dunedin ..	133	5	80	14	13	8	86	27	6	126
Queenstown	—	8	24	5	14	7	23	38	137	109
Southland ..	170	18	58	57	21	6	73	68	64	0
Waitangi, Chatham I. †	253	61	34	24	38	17	93	21	45	2

* These returns refer to the particular time of observation, and not to the whole twenty-four hours, and only show that no direction was recorded for the wind on that number of days.

† For 11 months only.

TABLE IV.—Bealey (Interior of Canterbury), at 2,104 feet above the sea.
1879.

Mean Annual Temp.	Mean Daily Range of Temp. for year.	Extreme Range of Temp. for year.	Mean Barometer reading for year.	Range of Barometer for year.	Mean Elastic Force of Vapour for year.	Mean Degree of Moisture for year.	Total Rainfall.	Mean Amount of Cloud.
Degrees.	Degrees.	Degrees.	Inches.	Inches.	Inches.	Sat.=100.	Inches.	0—10.
†46·5	†16·4	67·3	29·773*	1·604	†207	†65	70·320	5·4

† 11 months only. * Reduced to sea level.

TABLE V.—Earthquakes reported in New Zealand during 1879.

Place.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Taranaki ..	..	..	..	..	..	..	..	..	17*	..	17, 19	..	3
Napier ..	16*	..	..	..	..	..	..	..	..	30	..	..	2
Wanganui ..	5* 12	..	..	..	..	..	21	..	..	..	..	..	3
Palmerston Nt'h	..	..	..	..	..	..	..	..	..	30*	..	..	
Foxton ..	..	..	..	..	..	..	..	..	..	30*	..	..	
Wellington	5* 12*	..	..	24	3, 25	..	27	5*, 8, 18	..	30*	17	..	11
Cape Campbell	..	..	4	..	3	..	..	..	..	30	..	..	3
Christchurch ..	..	..	..	..	..	..	22*	..	..	..	17	..	2
Bealey ..	..	..	..	..	..	..	..	..	23*	..	..	..	1
Queenstown ..	..	..	..	20	..	..	9	..	..	..	25	25	4
Waitangi, Chatham Islands	..	..	..	..	9	..	..	..	..	..	..	..	1

The figures denote the days of the month on which one or more shocks were felt. Those with an asterisk affixed were described as *smart*. The remainder were only slight tremours, and no doubt escaped record at most stations, there being no instrumental means employed for their detection. This table is therefore not reliable so far as indicating the geographical distribution of the shocks.

TABLE VI.—COMPARATIVE ABSTRACT for 1879 and previous Years.

STATIONS.	BAROMETER.		TEMPERATURE from Self-registering Instruments, read in Morning for 24 hours previously.					COMPUTED FROM OBSERVATIONS.		RAIN.		WIND.		CLOUD.
	Mean reading.	Extreme Range.	Mean Temp. in Shade.	Mean Daily Range of Temp.	Extreme Range of Temp.	Max. Temp. in Sun's Rays.	Min. Temp. on Grass.	Mean Elastic Force of Vapour.	Mean Degree of Moisture (Saturation=100)	Total Rainfall in Inches.	No. of Days on which Rain fell.	Average Daily Force in Miles for Year.	Maximum Velocity in Miles in any 24 hours, and Date.	Mean Amount (0 to 10).
NORTH ISLAND.														
Mongonui ..	29·993	1·648	61·6	17·1	50·0	—	—	·427	77	58·920	191	180	798—26 June	6·4
Previous 12 yrs	29·949	—	60·6	—	—	—	—	§·424	§76	54·698	166	—	—	—
Auckland ..	29·990	1·546	59·1	13·5	48·2	149·2	31·1	·385	76	46·130	197	280	829—6 June	6·3
Previous 14 yrs	29·994	—	59·5	—	—	—	—	·409	79	44·345	188	—	—	—
Taranaki ..	29·964	1·470	56·8	16·1	53·0	149·0	29·0	·362	77	60·180	174	215	710—13 August	5·9
Previous 14 yrs	29·940	—	57·3	—	—	—	—	**·371	**74	56·462	161	—	—	—
Napier ..	29·964	1·551	58·8	13·2	49·0	141·0	29·0	·361	72	53·140	130	196	495—18 Feb.	3·1
Previous 10 yrs	29·938	—	58·8	—	—	—	—	·384	74	36·195	108	—	—	—
Wellington ..	29·961	1·545	55·1	12·2	48·1	147·0	29·0	·356	81	57·441	191	205	520—10 Nov.	5·2
Previous 14 yrs	29·905	—	54·8	—	—	—	—	·382	72	51·666	157	—	—	—
SOUTH ISLAND.														
Nelson ..	29·909	1·441	54·9	22·0	58·0	—	—	·340	78	61·420	117	138	375—4 April	5·2
Previous 14 yrs	29·893	—	55·5	—	—	—	—	·361	74	62·575	88	—	—	—
Cape Campbell	*30·058	1·460	*57·0	9·4	41·0	—	—	*·347	*75	*23·990	*71	*425	1,300—22 April	*6·6
Previous 4 yrs	29·990	—	57·9	—	—	—	—	·367	75	19·667	93	—	—	—
Christchurch ..	29·936	1·803	52·3	16·8	65·7	155·0	18·3	·279	71	23·180	126	142	656—5 October	6·4
Previous 14 yrs	29 884	—	53·3	—	—	—	—	·324	76	25·719	118	—	—	—
Bealey ..	29·773	1·604	*46·5	16·4	67·3	—	5·0	*·207	*65	70·320	170	—	—	5·4
Previous 10 yrs	29·836	—	46·4	—	—	—	—	·253	77	98·554	171	—	—	—
Hokitika ..	29·935	1·691	52·8	14·6	47·0	147·5	22·0	·336	83	128·295	199	—	—	5·5
Previous 12 yrs	29·930	—	52·6	—	—	—	—	·345	85	116·097	188	—	—	—
Dunedin ..	29·871	1·895	50·0	12·9	49·0	—	26·0	·277	76	42·099	184	133	690—7 August	6·4
Previous 14 yrs	29·825	—	50·5	—	—	—	—	·280	74	34·092	160	—	—	—
Queenstown ..	29·843	1·700	49·5	17·8	61·2	—	—	·240	67	22·420	121	—	—	5·6
Previous 6 yrs	¶29·840	—	50·4	—	—	—	—	·244	66	31·607	120	—	—	—
Southland ..	29·850	1·910	49·7	19·6	68·0	152·0	13·0	·278	77	33·260	175	170	533—15 Dec.	6·6
Previous 13 yrs	29·805	—	†49·9	—	—	—	—	‖·274	‖75	44·967	174	—	—	—
Waitangi, Chatham Ids.	*29·797	1·650	*51·8	9·6	35·0	—	—	*·330	*85	*26·290	*163	*253	673—26 May	*5·2

¶ Previous 5 years. † Previous 9 years. § Previous 11 years. ** Previous 13 years. ‖ Previous 8 years. * 11 months only.

NOTES ON THE WEATHER DURING 1879.

JANUARY.—Generally fine weather for time of year throughout with small rainfall; the temperature about the average, and high atmospheric pressure; winds on the whole moderate. Earthquake at Napier on 16th at 10.45 p.m. sharp; at Wanganui on 5th, at 8.47 and 9.50 p.m., sharp, and on 12th at 6.20 p.m., slight; at Wellington on 5th at 8.45 a.m. smart, and 12th at 6.42 p.m., smart, with noise.

FEBRUARY.—On the whole fine seasonable weather, except at some of the southern stations. The rain was light, and the temperature throughout rather below the average.

MARCH.—Rain generally in excess, but intervals of very fine bright weather experienced throughout. No storms of great violence recorded. Earthquake at Cape Campbell on 4th at 11.30 p.m., slight.

APRIL.—Very fine weather generally throughout; high barometer readings; temperature below the average, and small rainfall; winds on the whole moderate. Earthquake at Wellington, 24th, at 10.55 p.m., slight; Queenstown, 20th, at 12 p.m., slight.

MAY.—The rainfall at northerly stations was in excess, but, otherwise, below average for time of year; the temperature throughout was above the average, and, on the whole, the weather was fine for this period; a strong southerly wind occurred at most stations about the 11th; the amount of cloud was unusually high throughout. Earthquakes at Wellington on 3rd, between 2 and 3 a.m., slight; and on 25th, at 12.16 p.m., N.W. to S.E., slight; at Cape Campbell, on 3rd, at 2 a.m.; Waitangi (Chatham Islands) on 9th, at 1 a.m.

JUNE.—On the whole wet, squally, and cold weather was experienced during this period; the rainfall at most places in excess; the temperature about the average, and barometer readings very low.

JULY.—Rather colder and more severe than usual for this month; a good deal of snow and frost in the South, and squally from S.W.; very showery, but the total rain about the average. Earthquake at Wellington on 27th, at 6.15 a.m., slight; at Christchurch on 22nd, at 10.15 p.m., sharp; at Queenstown, on 9th, at 2.35 p.m., slight; at Wanganui on 21st, at 10.40 p.m., slight.

AUGUST.—Fine weather throughout for time of year with moderate winds, the latter part of month very fine, with high barometer readings at all stations, reaching 30·790 inches. Earthquakes felt at Wellington on 5th, at 7.45 a.m., smart with noise; on the 8th, at noon, slight; and on 18th, at 3.30 p.m., very slight.

SEPTEMBER.—At many of the stations the rain was in excess, but on the whole the fall was about the average. The weather was generally fine; at times strong winds occurred, chiefly from the westward, but no severe gales. Earthquake at Taranaki on 17th, at 8.15 a.m.; and at Bealey on 23rd, at 4.4 a.m., sharp.

OCTOBER.—Fine pleasant weather experienced at most of the stations; rainfall about the average; winds variable, and generally moderate. Earthquakes occurred on the 30th at New Plymouth, at 2.30 a.m.; at Napier, at 2.15 a.m., slight; at Palmerston North, and Foxton, at 2.25 a.m., sharp; at Wellington, at 2.25 a.m., sharp; and at Cape Campbell, at 2.30 a.m., slight.

NOVEMBER.—Very wet, unpleasant weather; stormy, chiefly from N.W., with frequent thunder. Earthquakes on 17th, at New Plymouth, at 6 a.m.; at Wellington, at 6.10 a.m., slight; at Christchurch, at 12.15 p.m., sharp; at New Plymouth, on 19th, at 6.10 a.m.; and on the 25th, at Queenstown, at 2.20 p.m., slight.

DECEMBER.—Early part generally fine at northern stations, and remainder very wet, squally, and unpleasant; in the South wet, stormy weather almost throughout; prevailing N.W. winds. Earthquake felt at Queenstown on 25th, at 6.30 a.m., slight.

RECORD OF PAPERS ON NEW ZEALAND NATURAL HISTORY, 1879–80.

[*Continued from Vol. XI.*]

New Species of Plants from New Zealand. Dr. Berggren. Trans. Royal Society, Lund. Plates I.–VIII.

Catalog der Gattungen, *Murex*, *Cominella*. *Euthria*, *Struthiolaria*, *Triton*, and *Voluta*. W. Kobelt. Jahrbuch der deutschen malakozoologischen Gesellschaft, 1878.

Hemiptera of New Zealand. F. Buchanan White. Entomologists' Monthly Magazine (1879), XV., p. 217.

On a new Penguin from Campbell Island. Hutton. Lin. Soc. of N.S.W., III., p. 334.

On a small Collection of Heterocerous *Lepidoptera* from New Zealand. A. G. Butler. Cistula Entomologica, II., Aug. 1879, p. 487. London (Janson).

Description of a new Rail from Macquarie Island. Hutton. Ibis, 1879, p. 454.

On *Harpa novæ-zealandiæ* (Gml). Hutton. Ibis, 1879, p. 456.

The Structure of *Amphibola avellana*. Hutton. Ann. Nat. Hist., series 5, Vol. III., p. 181.

Additions to the Amphipodous *Crustacea* of New Zealand. G. M. Thomson, Ann. Nat. Hist., series 5, Vol. IV., p. 329.

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